

Surviving the Crises: The Changing Patterns of Space Cooperation among the United States, Russia, Europe, and China

**Paper prepared for ECPR SGIR 7th Pan-European Conference on IR
9-11 September 2010
Stockholm, Sweden**

SHENG-CHIH WANG*
Ph.D. Candidate
Department of Political and Social Sciences
Free University of Berlin, Germany

Abstract

How can we better explain the pattern variation of international space cooperation under economic stress? International cooperation in large-scale space application programs has become a cost-effective instrument to achieve foreign policy goals and to balance colossal expenditure deriving from natural and technological constraints, particularly under budgetary stringency. However, cooperation patterns vary between different participants. For instance, US-Russian cooperation and Sino-European cooperation involve substantial transfer of technologies or funds, while US-European cooperation does not. This paper seeks to construct the causal mechanism of variant space cooperation patterns among the United States, Russia, Europe, and China. This paper argues that the pattern variation is caused by their cost-effective calculation of individual interests according to different international and domestic structural situations, in which new strategic partnership can be built between rivals, and latent conflicts between allies may be reinvigorated.

* Address Correspondence to Sheng-Chih Wang, Ostpreussendamm 27, 12207 Berlin, Germany.
E-mail: sc.wang@fu-berlin.de

1. Introduction

How can we better explain the pattern variation of international space¹ cooperation under economic stress? Space is a capital concentrated and high technological threshold policy domain. Only those who possess required capital and technological capabilities can join the game of the Space Club, in which the United States (US), the Union of Soviet Socialist Republics (USSR)/Russia, Europe,² and the People's Republic of China (PRC) are the major players. In the Space Age, space cooperation alternates with competition among these major space-faring states.³ However, when they encounter economic stress and budgetary stringency, international cooperation in large-scale space application programs becomes a more desirable (i.e., cost-effective) instrument to balance colossal expenditure deriving from natural and technological constraints as well as to achieve their respective space and foreign policy goals. Nevertheless, cooperation pattern varies between different participants. For example, US-USSR/Russian cooperation in the Apollo-Soyuz Test Program (ASTP), Shuttle-Mir program, and International Space Station (ISS) program, as well as the Sino-European cooperation in the Galileo satellite navigation program involve substantial transfer of technologies and funds, while US-European cooperation in the ISS program and the Galileo program tries to prevent that transfer.

This paper attempts to establish two interconnected arguments to account for such pattern variation. First, pragmatic and flexible balance of respective domestic and foreign policy interests causes the pattern variation of international space cooperation between different participants. In other words, space-faring states conduct cost-effective calculation of individual interests according to the international and domestic structural situations, in which new strategic partnership can be built between rivals, and latent conflicts between allies may be reinvigorated.

Second, this paper argues that rationalist theories of international relations (IR) offer better explanations than the constructivist emphasis on the influence of common culture and identity. This paper deals with international cooperation problem and tries

¹ I reserve the term "space" for "outer space" owing to the common usage in space policy study. The term "spatiality" in this paper refers to a specific spatial setting that has effects on human activities.

² I confine Europe to the political institutions and member states of the European Union and the European Space Agency rather than the elusive historical or cultural definitions. This circumscription not only reduces the degree of confusion, but also points out the main European policymaking institutions in space politics.

³ The Cold War superpower rivalry and the launch of USSR Sputnik I satellite on 4 October 1957 sparked the dawn of Space Age. The subsequent evolution of space technologies was termed as a "saltation" by McDougall (1982, 1011; 1985, 6), that is, an abrupt discontinuous leap in the relationship of states to the creation of new knowledge, and the transformation of governments to embrace technocracy and perpetual technological revolution. The international structure in the Space Age gives governments no choice but to transform to technocracy, develop full-scale space capabilities, and adjust inherited institutions and values to achieve leadership, autonomy, or dominance in space.

to evaluate systematically the explanatory strengths of rationalist IR theories on states' practice in space issue area. International cooperation problem remains a core debate among competing IR theories. Scholars from rational choice and social constructivist metatheories developed several theories to study international cooperation problem. Theories derived from rational choice metatheory underscore actors' capacity to make rational decisions within definite constraints such as imperfect information (Smith 1998, 131, 172). These theories assume that the "logic of consequences" defines and guides actors' preference and behavior. Actors are purposively rational and calculate various courses of action based on minimizing costs and maximizing benefits (i.e., minimax strategies). Realism, hegemonic stability theory, and neoliberal institutionalism tackle international cooperation problem from this rationalist origin.

In contrast, theories derived from social constructivist metatheory emphasize the constitutive and regulative effects of idea, norm, culture, and identity. These theories assume that the "logic of appropriateness" defines and guides actors' preference and behavior. Actors pursue rule-based legitimacy that is associated with their common cultures, collective identities, shared values and norms embedded in institutions or other social structures rather than purely calculate individual interests (March and Olsen 1999, 311; Fierke 2007, 170). This paper points out the problematic regulative effect of these ideational factors on states' behavior in space politics, but does not deny their existence and constitutive effect.

More specifically, we can better understand the pattern variation of international space cooperation through a strategic setting. The strategic setting consists of preferences and beliefs of egoistic actors and the structural situation in which they interact. According to Lake and Powell (1999, 9-11), preference is actor's ranking of possible outcomes. Belief is actor's perception of others' preference, and it affects the formation of the actor's preference. Here I integrate belief into preference as that states' space policy preferences⁴ contain the consideration of other's preference. In other words, states take their anticipation of others' preference into account when they choose their own strategy. Structural situation refers to the interaction environment, which comprises available options for actors and "an information structure that defines what the actors can know for sure and what they have to infer [...] from the behavior of others" (Lake and Powell 1999, 8-9; see also Glaser 2010). The resultant strategy is determined by the interest configuration of states' preferences in a specific structural situation. Accordingly, different interest

⁴ Space policy preferences can be categorized into symbolic and functional ones. Symbolic preferences encompass political interests such as prestige, propaganda, policy legitimization, accountability, and national security. Functional preferences refer to economic, technological, and scientific interests. Details see Sadeh 2002b, 308.

configurations of states' space policy preferences in different structural situations will generate variant strategies in international space politics. This is why states cooperate in some programs, and simultaneously compete in others.

This paper is primarily written from a rationalist perspective. It takes the perspective of rational and purposive states decide to cooperate or compete by making cost-effective calculation of individual interests when they interact under the constraints and opportunities that the international and domestic structures yield. For IR theories, the most fundamental and pressing questions are the causes of international cooperation and competition. International space politics also contains critical cooperation problem (i.e., the feasibility and conditions for cooperation) that needs to be better researched. However, the literature of IR theory seldom notices the theoretical implications of space politics, while space policy study lacks theoretical perspectives. In other words, the connection between IR theories and international space politics is not well established. Therefore, I attempt to bridge them.

In my earlier study, I make an effort to couple IR theories with political geography approaches in explaining transatlantic space politics (Wang 2009). I establish a theoretical explanation, in which identifies the predominant concerns of sovereignty and classical geopolitical interests, the marginalization of ideological conflict and European security dependence during the Cold War, as well as the problematic regulative effect of the transatlantic security community on transatlantic space politics. This paper expands this preliminary work by sophisticating empirical description and providing a precise and empirical-informed theoretical explanation for the causal mechanism of pattern variation in international space cooperation.

The number of large-scale space application program that involve significant cooperation among the US, the USSR/Russia, Europe, and the PRC is not large enough to conduct quantitative large-N study. As a result, I adopt qualitative approach and small-n interpretative (or disciplined configurative) case study (Lijphart 1971; Bennett 2004; George and Bennett 2005) as the strategy to reach the answer of my research question. In addition, the method of qualitative small-n case study facilitates the analysis of important but difficult-to-quantify variables such as space policy preference, interest, international and domestic structures, cooperation, and competition, and theoretically significant but previously ignored cases such as the ISS and Galileo programs (cf. Mitchell and Bernauer 1998, 6-7). Moreover, this paper seeks to explain why and how, but not to confirm whether, rational cost-effective calculation of strategic self-interests causes the pattern variation of international space cooperation. Small-n and in-depth case study is more adequate to identify the causal mechanism between my study variables rather than merely their correlation.

This paper investigates two significant large-scale space application programs

that involve intensive political interaction among the US, Russia, Europe, and the PRC under certain economic stress and budgetary stringency. The first case is the cooperation among the US, Europe, and Russia in the ISS program. The US selected Canada, Europe, and Japan as original partners in the 1980s, and invited Russia to the program in the early 1990s according to US individual interests after the Cold War. In the ISS program, the US transferred the funds of the National Aeronautics and Space Administration (NASA) to Russia in exchange for the hardware of Russian Mir space station. However, the US rigidly prevented any transfer of technology and fund to Europe. In order to protect its own interests against US domestic budgetary stringency and numerous redesigns on the space station program, Europe conceived a Russo-European space station without US participation. However, Russia failed to meet the requirement because of its tumbling economy, therefore made the US-led ISS program the only means to achieve their respective space policy goals.

The second case is US-European cooperation and Sino-European cooperation in the Galileo satellite navigation program. Europe initiated the Galileo program in order to develop autonomous capability of security management in response to unreliable data provision of the US Global Positioning System (GPS). The US opposed the Galileo program for signal interference and breaking its protection of navigation data from antagonistic use. Europe then exchanged technologies and funds with the PRC in the Galileo program regardless of US strategy of technological containment against the PRC. However, the post-September 11 security needs, unexpected shortage of Galileo funds, and commercial pressures on Europe compelled the US and Europe to shift their strategies to ensure the compatibility and interoperability between the US GPS and European Galileo system.

In the empirical analysis of these cases, I focus on international and domestic structural factors that yield constraints and opportunities for these space-faring states. While Russia and the PRC are less problematic to be treated as unitary actors that primarily response to the international structure, Europe and the US should not be treated as homogeneous unitary actors because their preferred strategies are derived from the response to both domestic interests and the international structure. The US domestic politics is a complex process of bureaucratic bargaining that involves competing interests of various departments and sectors. For Europe, its coherent strategy is derived mainly from the bargaining among the related member states and institutions. Nevertheless, I should omit the domestic politics of individual European state for pragmatic reasons.

Although space technologies contain both civilian and military applications, this paper primarily deals with civilian space exploitation. This treatment does not obliterate the strategic and security significance of space technologies. For example,

The ASTP involved the exchange of sensitive spacecraft docking technology, which reflected the convergence of US and USSR preferences in mitigating the Cold War tension. Besides, the ISS contains a critical strategic prospect of extending the sphere of human activities, both civilian and military, from near earth space to lunar and solar space. Moreover, the US troops have used extensively the precise signal of GPS in military operations, and that of the Galileo system does not exclude military application. The US opposed the Galileo system because it invalidated the US effort to prevent satellite navigation data from antagonistic use against the US, and the technological and financial exchange between Europe and the PRC in the Galileo program might enhance the PRC's military capability against the US in East Asia. The list is not exhausted. The cases selected in this paper contain abundant geopolitical and security substances even though they are civilian space programs.

For civilian space exploitation, this paper does not include the plethora of international cooperation in space science programs. I emphasize particularly the importance of space application programs. Space application programs, such as construction and utilization of launch vehicle, space station, and navigation satellite system, have substantial and immediate impacts on state interests as well as on the patterns through which international politics proceeds, while space science programs do not. For example, the discovery of a black hole or super nova at millions light years away would cause very little, if any, impact on states' interests and international politics, unless we have developed "inter-galaxies" flight capability and "interplanetary relations" that would be influenced by these celestial bodies.

This paper does not discuss civil commercial issues either. We should distinguish between civil commercial interaction and strategic commercial interaction according to their significance to states' interests (cf. Van Scherpenberg 2008). Civil commercial competition, such as those over agricultural trade and automobile industrial relations, are the results of wrestle among different interest groups in domestic policymaking process that aims at maximizing social welfare. Strategic commercial disputes, such as those over dual-use technologies, directly touch upon states' security interests. While international cooperation and competition in civil commercial issues indicate little political substance, those in strategic commercial issues like rocketry, spacecrafts docking, and dual-use navigation satellite system are much more political that prompts us to identify their genuine causal mechanism.

The empirical data of the two case studies rely on unclassified material from governmental documents, official reports, technical reports, and academic literature. These empirical materials contain abundant information about states' preferences in different international and domestic structures. Careful tracing of these data should reveal the genuine causal mechanism of the pattern variation in international space

cooperation. Besides, a single unexpected piece of process tracing evidence may alter the historical interpretation and theoretical significance of the cases (George and Bennett 2005, 13).

This paper proceeds in four parts. After the introduction, the second section elaborates the hypotheses of rationalist IR theories that illustrate the conditions under which states cooperate. These theories include realism, neoliberal institutionalism, and hegemonic stability theory. The third section conducts two case studies that involve intensive political negotiations among the US, Russia, Europe, and the PRC triggered by economic stress and budgetary stringency. The final section synthetically analyzes the cases and finds out that neoliberal institutionalism explains not only the causal mechanism of US-European interaction, but also Russo-US and Sino-European interaction, which is regarded conventionally as the realm of realist explanation. This paper concludes that economic crises did not lead to power shift from states to non-state actors. Space remains a state-dominant and geopolitically demarcated realm.

2. Assumptions and Hypotheses of Rationalist IR Theories

To couple rationalist IR theories with international space politics, we need a clear understanding of the assumptions and hypotheses of each theory. We should also identify what precisely is the expectation of each theory regarding international space cooperation. Therefore, this section elaborates the assumptions and hypotheses to be evaluated in the case studies. I discuss three rationalist IR theories that provide possible explanations for the pattern variation in international space cooperation.

2.1. Realism: Formation of Expedient Counterbalancing Alliance

The intellectual foundation of realism can be traced back to the work of the ancient Greek historian Thucydides on the history of the Peloponnesian War (Finley 1972), in which Thucydides accentuates the importance of power and states' aptitude for the formation of counterbalancing alliance (Dougherty and Pfaltzgraff 2001, 69; Lebow 2007). The representative argument of this work in the chapter of the Melian Dialogue—"the strong do what they have the power to do and the weak accept what they have to accept" (Finley 1972, 402)—manifests the central thought in the works of succeeding realists. However, to conduct a comprehensive historical discussion of political realism strays from the purpose of this dissertation. I primarily discuss the contemporary realist IR theories developed in the twentieth century that tackle international cooperation problem.

According to Lynn-Jones and Miller (1995, ix), "[r]ealism is a general approach to international politics, not a single theory." The contemporary realist paradigm is

composed of several strands of theories. The first is classical realism (Morgenthau 1948; Liska 1962; Wolfers 1962). Classical realism in the tradition of Morgenthau focuses on the unit level and the international system level. It infers states' motive from a fixed human nature of endless struggle for power, and points out that the pattern of balance of power is a "necessary outgrowth" of power politics, and is occasioned by changes of the distribution of power in the anarchic international system (Morgenthau 1967, 161; Donnelly 2000, 11-12).

More specifically, classical realism starts from the egoistic predisposition of human nature. In order to ensure our own survival and security, we have no choice but to aggregate as much more power as possible. As the extension of human beings, states have to struggle for power as well in order to survive in the anarchic international system. Those who abstain from aggregating power are regarded as committing suicide (or irrational). The best and rational foreign policy is to pursue advantageous power position by maintaining or overthrowing the status quo of power distribution, which leads to the configuration of balance of power embodied in the formation and dissolution of counterbalancing alliances. Balance of power is the best and rational foreign policy because it "minimizes risks and maximizes benefits," and is "an essential stabilizing factor in a society of sovereign [states]" (Morgenthau 1967, 4-14, 161; Guzzini 1998, 23-30). In other words, the human nature and the anarchic international system make states struggle for relative power as assurance of their survival and security. Such individual struggle for relative power leads to conflict between rival alliances and expedient cooperation within each alliance. In sum, state interest defined in terms of relative power (i.e., power as the ultimate goal of states) is the core concept of classical realist perspective on international relations.

The second strand is structural realism (Waltz 1979). Waltz's structural realism provides a parsimonious theory by focusing on the international system level. It tries to "scientifically" refine and reinterpret classical realism in response to the changing global power distribution in the 1970s. Structural realism emphasizes the structural analysis of global power distribution. Waltz articulates clearly that his systemic theory is different from what he terms "reductionist theory" that aims at explaining international competition and cooperation from the domestic sources of states' foreign policies (Waltz 1979, 18-37; Donnelly 2000, 83). Different from classical realist conception of power and its concentration on military dimension, Waltz argues that the structure of the international system, rather than human nature, compels states to pursue power. Besides, power is a means to achieve security rather than an end per se. Security is the highest and ultimate concern of states in the anarchic international system. In order to achieve security, states must increase and combine their power in various dimensions (e.g., economic, military, technological, and political) rather than

only focus on military power (Waltz 1979, 126, 131; 1990, 34-36).

More specifically, structural realism treats states as unitary and functionally similar actors that at a minimum seek their own preservation, and at a maximum pursue hegemonic status (Waltz 1979, 118). The structure of the international system emerges from the interaction of states, and in turn “constrains them from taking certain actions while propelling them toward others,”⁵ that is, the balance of power on which states security depends (Waltz 1990, 29; Dougherty and Pfaltzgraff 2001, 82). Balance of power is particularly important to weak states’ security, because an imbalance of power may tempt stronger states to project their power, therefore threaten the survival and security of weak states (Waltz 1979, 118, 132; 1993, 74). Therefore, once the balance of power is upset, states will try to restore it in one way or another as soon as possible (Waltz 1979, 128). According to Waltz (1979, 118), states try to achieve balance of power with two means: internal efforts and external efforts. Internal efforts refer to increasing economic capability, military strength, and clever strategies. External efforts refer to forming a counterbalancing alliance and weakening the opposing one.

There are two ramifications within structural realism: offensive realism and defensive realism. The central question that divides them is “How much power is enough for states’ security?” Offensive realism argues that states are power maximizers that they regard attaining hegemonic status as the best assurance of their survival and security because the hegemonic status is difficult to be threatened by other states, therefore leads to endless competition or war among states (Labs 1997; Mearsheimer 2001). In contrast, defensive realism argues that states do not always try to maximize their power because the pursuit of hegemonic status may lead to punishment from the system. They can ensure their survival and security through defensive strategies that minimize their losses of relative power or prevent other states from attaining advantageous position (Walt 1987; 1998; Van Evera 1999). The formation of expedient counterbalancing alliance against security threat is the cost-effective strategy for defensive realists. Waltz’s theory can be regarded as a version of defensive realism for he argues that “[t]he first concern of state is not to maximize power but to maintain their positions in the system” (Waltz 1979, 126). Nevertheless, offensive and defensive realism share a common perspective on the limited regulative effect of international institutions. Both Waltz (2002) and Mearsheimer (1994/95; 1995) argue that international institutions are the products of self-interest calculation of states, reflect only the distribution of power in the

⁵ According to Waltz (1979, 76), the anarchic structure constrains states behavior in two ways. The first is through the process of socialization. The second is through competition. The process of socialization causes similar attributes and behavior of states. Competition generates an order in which states adjust their relative power relations through their autonomous decisions and actions.

international system, have no regulative effect on the relentless security competition among states, and are subordinated to states' purposes.

The third strand is neoclassical realism (Wohlforth 1993; Glaser 1994/95; Rose 1998; Schweller 2006). Neoclassical realism shares structural realist assumptions of the anarchic self-help international system and rational states' goal of pursuing security. However, for neoclassical realism, anarchy only refers to the international structure in which states interact rather than inevitable competition among states. Neoclassical realism argues that to explain international outcomes, we should pay attention to the domestic influence on states' behavior because "systemic pressures must be translated through intervening variables at the unit level" (Rose 1998, 146). In other words, neoclassical realism emphasizes the importance of policy-maker's cognition and other domestic variables in complementing the systemic explanation of structural realism. It starts from classical realist conception of state, which is a purposive organization distinct from society, and argues that states' domestic politics largely dictate their strategies to achieve survival in the anarchic international system (Mastanduno et al. 1989). It assumes the international structural constraints on states' choices of strategies as constant, and attributes the variation of states' strategy to the influence of their different domestic characteristics. In other words, it treats the different domestic characteristics as intervening variables and then tries to distinguish the conditions under which states prefer cooperative strategies from those under which states incline toward competition (Rose 1998, 154; Glaser 1994/95; 2010).

According to Glaser (1994/95, 60), structural realism emphasizes the inevitability of international competition and the risks of international cooperation. However, for neoclassical realism, both international cooperation and competition can be risky. In fact, the preferred strategies of states are determined through their cost-effectively calculation of the benefits and risks of cooperative and competitive strategies according to their domestic characteristics. If cooperative strategy contributes to state's security while competitive strategy undermines it, the state prefers the cooperative strategy (Glaser 1994/95, 60). This calculation is termed as the "offense-defense balance," which refers to the ratio of offense costs and defense costs (Glaser 1994/95, 61; Glaser and Kaufmann 1998; Van Evera 1998). The offense-defense balance should be established on the "offense-defense distinguishability" because states can choose between cooperative and competitive strategies only when the material forces for offense are distinguishable from those for defensive purposes (Glaser 1994/95, 61-64). In other words, states' choices between cooperative and competitive strategies are highly contingent on different configurations of motive, capability, and information variables. States do not always prefer competition (Glaser 1994/95; 2010, 1-15). In order to solve the security

dilemma, states may choose from a variety of strategies such as concessions, negotiations, bandwagoning, forming counterbalancing alliances, or go to war.

Despite the divergence mentioned above, neoclassical realism assumes that states calculate the impact of international cooperation in terms of relative gains, which may impede cooperation between allies (Glaser 2010, 51n). It also denies the independent function of international institutions that facilitate international cooperation. According to Glaser (2010, 17):

“On institutions, my theory finds that they matter but does not establish a central role for them that is comparable to the one identified by neo-institutionalism. [...] the theory finds the deep sources of international security cooperation in the states’ international environment and their motives, not in the international security institutions that they create.”

Although these strands of realist theories focus on different levels of analysis, they share at least six interrelated assumptions:

- (1) *The most salient characteristic of the international system is anarchy, which makes the international system a self-help system.*
- (2) *Egoistic and rational states are primary actors in the anarchic international system.*
- (3) *The basic interest of states is to maintain their own survival and security defined in terms of relative power.*
- (4) *The essence of international relations is power politics.*
- (5) *Balance of power/threat is the best and rational foreign policy* (although different realist theories bestow different meanings on this concept).
- (6) *International institutions exist, but they are not the major cause of international cooperation. The regulative effect of international institutions is contingent on states’ interests and relative capabilities rather than independent of them.*

The next step is to specify the realist expectation regarding the conditions under which states are likely to cooperate and compete in international space politics. States are likely to cooperate under two conditions. The first is when they encounter common security threat that they cannot resist alone (Stein 1990, 6). The common threat does not necessarily derive from space issue area. It may come from other issue area but can be countered with states’ strategic space assets. Under this condition, realism leads us to expect states “to behave in ways that result in balances forming” (Waltz 1979, 125). States may possess certain degree of contradictory interests, that is, in a mixed-motive situation. However, survival is the most fundamental interest that they have to secure. Therefore, states will ensure their respective security by forming an expedient alliance that aggregates their capabilities against the common security

threat. However, within this alliance, states will not conduct substantial exchange such as transfer of sensitive technology or governmental funds because they fear that the substantial exchange may lead to asymmetric gains favoring others, who will use the advantageous position in controlling its political autonomy and freedom of space activities. Besides, the expedient alliance will dissolve with the elimination of the common security threat. The shared ideology or common culture is not a guarantee to sustain the expedient counterbalancing alliance (cf. Walt 1985). The realist line between allies and adversaries is not clear-cut, because today's ally may become adversary in the future (Glaser 2010, 51n).

The second condition is when there is no common security threat, and states possess some contradictory interests in the same space application field. Under this condition, realism leads us to expect states to conduct offense-defense calculation. They will calculate the benefits and risks of cooperative and competitive strategies according to respective space technological capabilities, information (e.g., perception of others' motives and capabilities, and the available options constrained by the international structure), and space policy goals that encompass domestic needs and expected international outcome. If cooperation contributes more to mitigate their contradictory interests (including political, military, economic, and social welfare interests) and competition cannot or costs too much to realize their respective interests, they will choose cooperative strategy to convey benign motive in order to solve the problem that generates their contradictive interests in the space application field. Similar to the first condition, states will not transfer any sensitive technology or governmental funds in order to prevent others from attaining advantageous position.

Accordingly, international space cooperation under the second condition should be contingent on the question of how states emphasize their relative gains when the cooperation is expected to cause asymmetric distribution of benefits. If the expected relative gains are too salient to be ignored, states will hesitate to cooperate (cf. Grieco 1988; 1993). Besides, the influence of relative gains concern on international space cooperation is beyond the border of any single issue area, because states define their interests in terms of the combination of political, military, economic, and social power. All of these dimensions contribute to states' security. For example, if states expect their cooperation in a space application program or field to cause asymmetric distribution of strategic economic gains that may lead to negative result in future development of military or political power, they will restrict the cooperation even though both of them can gain from it (cf. Liberman 1996).

If competition can realize their respective interests with low costs and cooperation may lead to disadvantageous position that is risky to future political autonomy and freedom of space activities, we should expect states to adopt

competitive strategies to achieve respective space policy goals.

2.2. Neoliberal Institutionalism: Cooperation through Institutional Regulation

Neoliberal institutionalism shares realist assumptions about the anarchic international system, states as rational and primary actors, and their predisposition of self-interest satisfaction (Keohane 1984; Baldwin 1993; Grieco 1993; Keohane and Martin 1995; Jervis 1999). However, neoliberal institutionalism proposes different perspectives on the role of power, states' interests under anarchy, and the function of international institutions. While anarchy is the most salient characteristic of the international structure, it is not the only one (Milner 1991, 85). International economic interdependence and international institutions are also characteristics at the international system level and they can affect the attribute of the structure of the international system. Neoliberal institutionalism, like neorealism, also tries to "explain behavioral regularities by examining the nature of decentralized international system" (Keohane 1989, 7). As a result, international institutions and interdependence should be taken into consideration when defining the structure of the international system (Buzan et al. 1993, 36-37; Dougherty and Pfaltzgraff 2001, 86) because they "play an important role in the distribution of wealth and power at the international level" (Martin 2007, 110).

For neoliberal institutionalism, to gain power resources is still an important state interest. However, according to Keohane (1986a, 194), "power resources are differentially effective across issue areas," and the usability of power is contingent on the policy domain within which it is required. Struggle for power is not states' ultimate goal or the only means to ensure security in an interdependent world. Instead, to maximize respective wealth is. For example, in international financial or trade issue area, states may have common interests in cooperation through which they expect to maximize respective economic benefits. In other words, states do not always compete for power because power is not their major concern in some issue areas.

Besides, states' contradictory interests derive primarily from imperfect information and bounded rationality rather than the predisposition of struggle for power. Imperfect information refers to the uncertainty about other states' motives, preferences, and future actions. Bounded rationality refers to the limited capability of policymakers in processing all potentially available information (Keohane 1984, 111-112). States fail to cooperate even when they possess common interests because they obtain imperfect information that leads to miscalculation and misperception. However, for neoliberal institutionalism, such miscalculation and misperception can be solved by intended manipulation (Stein 1990, 12; Jervis 1999). International

institutions emerge out of this requirement. For neoliberal institutionalism, international politics is both decentralized and institutionalized (Keohane 1989, 1). It primarily investigates the questions of how states cooperate to overcome the defection problem through the regulation of international institutions, and how much it costs if states fail to cooperate in the dense network of a highly interdependent world (Brooks and Wohlforth 2008, 8).

According to Stein, states require the regulation of international institutions to help them achieve cooperation under two conditions: dilemmas of common interests and dilemmas of common aversion (Stein 1990). Dilemmas of common interests refer to the collaboration problems typically represented by the Prisoners' Dilemma in which the configuration of states' independent rational strategies lead to Pareto-deficient outcomes (Krasner 1991, 341). If states want to achieve the Pareto-optimal outcomes that are more preferred, they must abandon their respective dominant strategies (Stein 1990, 32). However, because of the miscalculation and misperception caused by imperfect information and bounded rationality, states may fear others' defection that will lead to the worst outcome if they abandon their dominant strategies. Therefore, if states possess significant common interests, they will establish international institutions to mitigate the defection problem and facilitate cooperation that move them from Pareto-deficient to Pareto-optimal. In other words, if states possess significant common interests that can be realized only through cooperation, we should expect states to be bound to international institutions that prevent Pareto-deficient outcomes caused by uncoordinated policies.

Dilemmas of common aversion refer to the coordination problems characterized by states that possess common interests in avoiding particular outcomes (Stein 1990, 36). States must coordinate their strategies to avoid mutually undesirable outcomes. However, states may disagree about the terms of agreement as the most desirable outcome. International institutions can facilitate the convergence of states' interests in a particular set of rules that guide their policy coordination.

The collaboration and coordination problems are market failure problems. Market failure problems refer to the configuration of states' independent decision-making in market mediation results in Pareto-deficient outcomes. States fail to achieve the outcome that would be beneficial to all of them (Keohane 1984, 82). International institutions enable states to achieve preferred outcomes by providing information and making common interests prominent. This is what Martin and Simmons (1998, 752) term "convergence effects" of international institutions (see also Botcheva and Martin 2001). States' obedience to institutional rules with mutually beneficial exchange (i.e., reciprocity)⁶ is central to international cooperation

⁶ For detailed discussion and analysis of reciprocity in international politics, see Axelrod and Keohane

(Keohane 1982; 1986a; Stein 1993). According to Stein, this mutually beneficial exchange is based on comparative advantage, which “leads to a division of labor and to the growth of economic interdependence” (Stein 1990, 7), and in turn make cooperation a more cost-effective strategy to realize states’ common interests.

Neoliberal institutionalist solution to the market failure problems assumes all states possess symmetrical capabilities that render them equal competence to influence each other, therefore makes Krasner (1991) remind us to notice the distribution problem in cooperation under institutional regulation. He argues that we should pay more attention to the influence of states’ capabilities and distribution of benefits on cooperation than to the efforts of solving market failure problems (Krasner 1991, 337). Within international institutions, states may exert their power to “secure a more favorable distribution of benefits” rather than facilitating cooperation (Krasner 1991, 362). Perrow (1986, 132) makes an additional remark that states care about the distribution of benefits may render states the capabilities to control the institution, and thereby “bring with it a variety of rewards including security, power, and survival” (quoted from Krasner 1991, 362). Although power consideration leads to states’ struggle for favorable distribution of benefits in cooperation, this distribution problem can be solved also through power. According to Krasner (1991, 340), states’ power can be used in three ways to solve the distribution problem: (1) determining the major states who have a say in the negotiation, and excluding less powerful states; (2) deciding the rules of the negotiation; and (3) altering the payoff matrix to achieve their favorable outcomes.⁷

The distribution problem within international institutions indicates that neoliberal institutionalism assumes states possess both absolute and relative gains concerns when deciding to cooperate. It is naïve and dangerous to expect states to maximize absolute gains and do not care their disadvantageous relative gains, particularly vis-à-vis competitors. Keohane (1993, 274) also acknowledges that in addition to maximizing their respective absolute gains, states may also try to increase their relative gains from cooperation “through the use of political influence.” Keohane and Martin (1995, 45-46) further respond to Krasner’s emphasis on the distribution problem within international institutions by arguing that the distribution problem makes international institution indispensable to maintain cooperation:

“Disagreement about the specific form of cooperation is the principal barrier to cooperation in such coordination games. Unless some coordinating mechanism exists, states may fail to

1985; Keohane 1986b.

⁷ The power used to solve distributional problem contains three key elements: technology and market size, membership in international organizations, and control over sovereign territory. Details see Krasner 1991, 363.

capture the potential gains from cooperation [...] in complex situations involving many states, international institutions can step in to provide ‘constructed focal points’ that make particular cooperative outcomes prominent.”

And also,

“[T]he successful functioning of institutions depends heavily on the operation of reciprocity. Institutionalized reciprocity and distributional concerns are simply two sides of a coin, reflecting the difficulties of cooperating in a system lacking centralized enforcement and pointing to the need for reliable sources of information if states are to achieve gains from cooperation.”

In other words, the distribution problem can be solved through the regulation of international institutions rather than states’ power, because international institutions can provide information that makes states’ motive, preference, and future action predictable to each other, therefore ensures reciprocity and mitigates states’ misgiving about asymmetric gains from cooperation (cf. Martin and Simmons 1998, 745).

To summarize the content of neoliberal institutionalism, international institutions are treated simultaneously as causes/independent variable and effects/dependent variable of strategic interaction among rational and egoistic states (Keohane 1989; Keohane and Martin 1995; Martin and Simmons 1998). States create international institutions to satisfy their self-interest, and the international institutions reflect the distribution of power among states. Gradually, international institutions may “take on their own life” in reinforcing reciprocity, making cooperation more cost-effective, developing new norms, and changing states’ policies (Keohane 1984, 63; Axelrod and Keohane 1985, 250; Cox 1986, 219; Keohane 1993, 295; Martin and Simmons 1998, 746; Jervis 1999, 54). This is what Martin and Simmons (1998, 755) term “divergence effects” of international institutions (see also Botcheva and Martin 2001).

With this relatively optimistic perspective on international cooperation, neoliberal institutionalism predicts a different way of state behavior to achieve survival in the anarchic international system from the following assumptions:

- (1) *The most salient characteristic of the international system is anarchy, along with international institutions and interdependent network among states.*
- (2) *Egoistic and rational states are primary but not the only actors in the international system.*
- (3) *The basic interest of states is to maintain their own survival and security, but it does not render international cooperation impossible.*

(4) *The essence of international relations is not always power politics; states are utility maximizers rather than power maximizers.*

(5) *In mixed-motive situations, cooperation through institutional regulation is the best and rational foreign policy.*

(6) *International institutions are the major cause of international cooperation. They have independent regulative effect on states' behavior.*

The next step is to specify the neoliberal institutionalist expectation regarding the conditions under which states are likely to cooperate and compete in international space politics. States are likely to cooperate under two conditions. The first is when they possess common interests in the same space application program or field, but fear that individual reckless devotion may not achieve the beneficial outcome because of others' defection. Under this condition, neoliberal institutionalism leads us to expect states to establish international institutions that serve as regulative mechanisms and provide required information about others' motives, preferences, and future actions to facilitate international space cooperation. Like the solution of the defection problem, international institutions can also mitigate states' concerns about asymmetric distribution of benefits. The distribution of benefits from cooperation is not an important concern under this condition because the institutionally regulated cooperation is regarded as a mutually beneficial strategy to achieve their respective space policy goals.

The second condition under which states are likely to cooperate is when they possess both common interests and certain degree of contradictory interests in the same space application program or field (i.e., mixed-motive situation), and their common interests can be realized only through cooperation. If states' common interests are significant enough, we should expect them to establish international institutions in order to obtain required information and regulative mechanisms for cooperation, which is the only way to achieve their respective objectives.

More specifically, the prerequisite for states to cooperate in international space politics is the existence of substantial opportunities for joint gains ensured by institutional regulation. In this kind of mixed-motive situation, states will make long-term agreements (e.g., the signature of IGAs) with explicit rules and management interface to their joint application programs. Their concerns about the distribution problem (i.e., relative gains) will be mitigated by their commitment to reciprocity, that is, commitment to fulfill respective obligations to accomplish the joint space application program. These long-term agreements, explicit rules, and management interface, along with the dense international interdependence network, will in turn make cooperation more cost-effective for states in future interaction in international space politics.

In contrast, if states in a mixed-motive situation possess little common interests in the same space application field, the condition approximates a zero-sum game, and neoliberal institutionalist prediction will overlap with realist one that expects states to choose competitive strategies or reluctant to cooperate (cf. Keohane 1989; 1993, 278). In other words, there are not enough common interests among states as the incentive to make cooperation cost-effective. They cannot achieve respective space policy goals through cooperation. Furthermore, states' misgivings about asymmetric distribution of benefits may well impede international cooperation because the relative disadvantage in a relationship may undermine their own political autonomy and freedom of space activities. Under this condition, states tend to improve individual space technological capability and make autonomous decisions and unilateral acts that aim at attaining advantageous position in the same space application field.

2.3. Hegemonic Stability Theory: Symbiosis of Hegemonic Capability and International Cooperation

The concept of "hegemonic stability" was proposed by the liberal economist Charles P. Kindleberger. He argues that the major factors that lead to the world depression during 1929 and 1939 were Britain's inability and the US unwillingness to take on the responsibility of stabilizing international economy (Kindleberger 1973, 28, 291-292). For Kindleberger, to maintain a stable liberal international economy, there should be a single hegemonic state exerting strong political leadership and committed to liberal economic principles (Gilpin 2001, 94, 98).

Gilpin (1975) and Krasner (1976) also argue that an effective international economic order depends on the capability of the hegemonic state. The centralization of power on the hegemonic state facilitates the stability of international economic order, and the decentralization of power to several competing states will lead to a turbulent international economy. Gilpin (1987, 72) further points out that the hegemonic state must have the capability and willingness to establish and maintain the liberal international economic order. Besides, this order will become unstable with the decline of the hegemonic power.

According to Keohane (1980, 132, 137-138), hegemonic stability theory assumes the change of the power distribution among major states will lead to change in international institutions. Therefore, hegemonic stability theory is a "power-as-resources" theory that couples states' resources with states' behavior. An international system led by a hegemonic state is most favorable for the development of effective international institutions. These institutions will become ineffective with the collapse of the hegemonic system. Keohane (1984) has pointed out the bias and limitation of hegemonic stability theory, but he also holds that hegemonic stability

theory serves as a fundamental approach to study how state's resources affect the development of international institutions.

In short, the leadership of the hegemonic state engenders a stable international economic structure. However, we should not understand this claim as that a stable liberal international economy occurs only when a hegemonic state exists. As Gilpin argues, the existence of hegemon is "a necessary but not sufficient condition for the establishment of a liberal international economy" (Gilpin 2001, 94). In other words, an open and liberal international economy is "most likely to occur" when there is a hegemonic state in the international economic system (Katzenstein et al. 1999, 20). McKoewn (1983) criticizes that the international economic system is an oligopoly system rather than one of perfect competition. In an oligopoly system, the members will spontaneously provide the required public goods without any substantial inducement. Therefore, a stable international economic order can be maintained through the cooperation of a small group of major states (see also Olson 1965). However, according to Gilpin (2001, 93), McKoewn's critic lacks empirical support because this situation has never happened in history.

Indeed, the conception of hegemonic stability derives from the attributes of international public goods and the free-rider problem (i.e., to enjoy public goods without paying the costs). According to Snidal (1985, 590-595), the public goods under the assumption of hegemonic stability theory have three attributes: jointness, non-exclusion, and the impossibility of collective action. Jointness refers to that all states in the international system can benefit from consuming the public goods. One state's gains do not undermine that of others'. Non-exclusion refers to that no state can be excluded from enjoying the public goods. The impossibility of collective action refers to that states cannot cooperate to provide the public goods without the leadership of a hegemonic state because their respective self-interest concerns impede them from cooperation.

These attributes of international public goods render an incentive for states to "free ride" in a hegemonic system, since no state can be excluded from consuming the public goods provided by the hegemonic state (Wiener 1995, 222). In this situation, according to Gilpin (2001, 100), the public goods will decrease gradually because few states, if any, are willing to pay the costs of consuming them. Nevertheless, the hegemonic state provides public goods with self-imposed costs because the provision consists with its own interests. Krasner (1976, 322-323) makes an additional remark on this point that the hegemonic state benefits from providing public goods and maintaining liberal international economic order because it can easily find export markets for its products, and exert economic pressure upon other states, thereby achieve its political objectives. Gilpin (2001, 99) also argues that the hegemonic state

“created a liberal international economy primarily to promote its own interests and its political/security interests in particular” (see also Stein 1993, 48). The hegemonic state “manages” the international economic interaction to satisfy its own interests through the provision of public goods such as establishing and maintaining free trade system and global capital flow. Meanwhile, it must create an “effective international governance structure” (Gilpin 2001, 97) with its political and economic resources to solve the compliance problem and to sanction free-riders in order to maintain the stability of liberal international economic order.

Gilpin (1981) extends the static perspective on the relationship between hegemonic capability and liberal international economic order to a dynamic perspective on the change of the hegemonic system. Hegemons tend to decline, and the decline of hegemonic power threatens the stability of the international system (Grunberg 1990, 431; Kohout 2003, 55). Kohout (2003, 55-56) argues that the cost-effective calculation of available strategies explains the decline of hegemonic power and the rise of challengers:

“The hegemon is interested in keeping the status quo and hence must put more effort into this than other members of the system. Thus decline is relative but virtually inevitable because the costs of maintaining the dominance of security in the system are high, including military spending, stationing troops abroad, aid to allies, and the like. Together with a tendency to overemphasize consumption at the expense of investment, this situation leads to declining growth rates, and in the end the hegemon loses its economic and technological leadership. Whenever the hegemon’s resource base erodes, power shifts to other states.”

Hegemonic stability theory shares realist assumptions and therefore is a material approach. It posits the distribution of power as the key determinant of the stability of the international system. (Katzenstein et al. 1999, 21; Joseph 2008, 109). States try to satisfy their interests with respective cost-effective strategies, in such a situation, the best strategy is to struggle for relative advantageous power. If a hegemonic power declines, potential challengers will overthrow the status quo and change the existing rules of the system because they calculate it beneficial in doing so. The erosion of hegemonic resource base makes the hegemonic state gradually unable to afford the provision of public goods. It will adopt buck-passing policy or transfer additional burden onto other states, thereby undermines the legitimacy of hegemonic leadership and increases the benefit ratio to challenge the hegemon (Keohane 1980, 136-137; Gilpin 1981; 156-210; 1987, 73). Due to such dynamics of change, a stable hegemonic system cannot last forever.

In sum, hegemonic stability theory assumes a causal relationship between

hegemonic power and a stable international political and economic order. That is, the presence of a hegemonic state “leads to collectively desirable outcomes” in the international system, while the absence of a hegemonic state leads to undesirable outcomes and discord (Snidal 1985, 579). According to Wiener (1995, 220-222), hegemonic stability theory perceives international cooperation problem from both systemic and unit levels. The conception from the systemic level is “the provision of international authoritative structures, or public goods” by the hegemonic state. Hegemonic stability theory at this level emphasizes material resources that enable the hegemonic state to absorb the colossal costs of providing public goods and maintaining stability of the international system. The conception from the unit level is the ways in which the hegemonic state creates institutions or provides public goods to induce other states’ cooperation. Hegemonic stability theory at this level stresses the skills of the hegemonic state to reward compliance and sanction free-riders.

Hegemonic stability theory offers a parsimonious, though somewhat simplistic, explanation for the causes of international cooperation and competition from the following assumptions:

- (1) *The most salient characteristic of the international system is anarchy, which makes the international system a self-help system.*
- (2) *Egoistic and rational states are primary actors in the anarchic international system.*
- (3) *The basic interest of states is to maintain their own survival and security defined in terms of relative power.*
- (4) *The essence of international relations is power politics.*
- (5) *International institutions created and maintained by a hegemonic state facilitate international cooperation; however, the presence of a hegemonic state is a necessary but not sufficient condition for a stable international system.*

The next step is to specify the expectation of hegemonic stability theory regarding the conditions under which states are likely to cooperate and compete in international space politics. States are likely to cooperate in a specific space application program or field when they expect, with little or no costs, to benefit from consuming the public goods provided and maintained by the hegemonic state, and the hegemonic state is able to sanction the attempt to free ride. Under this condition, hegemonic stability theory leads us to expect the hegemonic state, according to its own interests, to induce other states’ cooperation (or compliance) by providing them with the benefits (e.g., hardware and know-how of critical technologies, or experience of human spaceflight and space habitation) that they cannot obtain by their own capabilities. Because the hegemonic power resources are limited, the hegemonic state may force other states to pay for the consumption of these public goods. If the

hegemonic state possesses enough resources and power to ensure other states' compliance and those states benefit more than the costs they pay, we should expect stable international space cooperation.

In contrast, states are likely to compete under two conditions. The first is when the hegemonic power declines so that it is unable to induce other states' compliance with the provision of beneficial public goods. The burdens of stable provision of public goods become gradually unbearable for the declining hegemon because of the erosion of its resource base. Under this condition, hegemonic stability theory leads us to expect the hegemonic state to transfer additional costs of maintaining the public goods onto other states, therefore undermines the legitimacy of its leadership and diminishes the willingness of other states to cooperate.

The second condition under which states are likely to compete is when other states possess space technological capabilities that are similar to or more advanced than the hegemonic one in the same application field, therefore makes the public goods provided by the hegemonic state unattractive and compliance with the hegemonic rules not cost-effective. Under this condition, hegemonic stability theory leads us to expect those states to be revisionists who try to challenge the hegemonic state in that space application field with their individual material buildup or through the formation of alliance. The hegemonic state will be incapable of bring them back to cooperation because its promises and coercion cease to be effective in dictating their behavior. To sum up, the extent of hegemonic resources and power determines the stability of international space cooperation.

3. Cases of International Space Cooperation

This section presents two in-depth case studies to evaluate the empirical validity of the theoretical hypotheses derived from the previous section, thereby identify the theory that provides plausible explanation for the pattern variation of international space cooperation.

3.1. US-European-Russian Cooperation in the ISS Program⁸

This case study investigates international cooperation in the ISS program since the 1980s. The ISS serves as a permanent human habitation in space. The experience

⁸ President Reagan named the US space station program officially as the Space Station Freedom in 1988 for the symbol of US leadership in the "free world" cooperation. After the end of the Cold War, NASA administrator Dan Goldin renamed it as the Space Station Alpha when incorporating Russian Mir space station. However, Russia opposed the code "Alpha" for it implies the world's first space station, which was not the truth. The space station was eventually renamed as the International Space Station while the US and the original partners confirmed Russia's participation. The term of the US-led space station program in this paper follows this timeline.

gained from the ISS operation can be applied to the Moon and Mars missions. Besides, manned spacecrafts flying to Mars should be assembled at the ISS owing to their enormous weight and size that can not be launched as an integral from the Earth. To wit, the completion of ISS is a significant prerequisite for human to go to the Moon, Mars, and beyond, which also means that controlling the ISS is a crucial step to control broader lunar and solar space.

This case study proceeds in four parts. The first part discusses the US decision on the space station program and international participation, particularly on the contention between budgetary stringency and visions in space. The second part discusses the European misgivings and rumination about US persuasion and Russia's participation. The third part elaborates the crises during cooperation, and provides several theoretical implicated observations that facilitate the examination of competing hypotheses. The fourth part examines the empirical validity of IR theories with the research findings.

3.1.1. United States Decision on Space Station: Budget Crisis versus Visions in Space

The Cold War structure generated US ambition of building a permanent manned space station. The approval for the space station program derived from NASA's political and technological compromises within the US bureaucracy. As the most ambitious and expensive space application program, the US space station program involved a broad range of agencies, together with their different, sometimes contradictory interests. These agencies were afraid that the space station would divvy their budgets. Under such domestic structural situation, NASA had to compete for funding, therefore made itself a typical political actor that must adopt conventional techniques to obtain the approval for the space station (Kay 1994, 146). It had to develop an encompassing strategy to deal with different interests concerning the space station. The proponents had to justify its benefits, attract support from different agencies, and convince the White House and Congress to accept the risks.

The strong political consensus in the US on ambitious space application programs disappeared in the post-Apollo era. The space station program therefore suffered Congress intervention, opposition of the White House staff, and, the most disastrous, several times of budget cut. The involvement of foreign partners served as a catalytic to the approval of the program because it dispersed the costs and symbolized the US superiority and leadership.

NASA's Incremental Strategy

Subsequent to the Apollo Moon landing in 1969, NASA claimed that the US

needs an ambitious vision of new application programs to maintain its superiority in space. NASA recommended three major goals for the post-Apollo program, including routine access to space with a reusable space shuttle, permanent manned space stations, and manned exploration mission to Mars. The three goals were serial steps for the US to achieve human occupation of space and thereby sustain US leadership in space exploration. Following the development of the Space Shuttle in the 1970s and its operationalization after 1981, NASA regarded the permanent manned space station as the “next logical step” to extend US space technological capabilities.

However, the space station program was forced to compromise on budget and technological terms in order to get approval. Just as McCurdy (1990, 32) argues about the Space Shuttle:

“The shuttle decision gave NASA its political baptism. Unable to get their overall vision approved, NASA scientists and engineers plunged into the morass of incremental politics. They had to negotiate shuttle design details with the White House staff. They felt obliged to accept a technologically inferior program in order to win political support, and they had to engage in the game of bureaucratic politics, seeking outside support from groups like the military, who came to NASA’s aid...NASA officials adopted a more utilitarian rationale. They turned to earth-bound arguments, in particular the cost effectiveness of the system for delivering payloads into orbit. They promised to make the shuttle cost effective when in fact their primary motivation for building it was not economic” (see also Johnson 2002, 262; Jenkins 2008, 99).

The space station program suffered similar tumbling political consensus and the shortage of funds necessary to make it work. The coherent support for Apollo program came from the response to US security and prestige emergency, which was conceived as “a modern technological challenge as threatening as an old-fashioned war” (McCurdy 1990, 23-25). Unfortunately, the structural situation that forged a solid political consensus on the Apollo program changed entirely in the 1980s.

As a result, NASA had to abandon the comprehensive strategy and instead adopted an incremental one. The first step was concept coordination. NASA did not provide a precise design of the space station. Rather, it invited all related agencies to propose their possible use of the space station, and thereby defined the possible functions that would be performed. The merit of this method was to induce more interests of related agencies and aggregate stronger coalitions to facilitate approval of the White House and Congress. According to Lambright and Schaefer (2004, 4), large-scale space application programs require strong coalitions to get resources. However, strong coalitions are hard to assemble, and even harder to sustain. NASA

had to struggle with numerous bureaucratic forces before it get the space station program approved.

The major obstacle came from the Office of Management and Budget (OMB). In early 1983, NASA perceived that the space station program could not be approved without submitting it for comprehensive White House review, particularly the OMB. The OMB reviewed the space station program for conformity with President Reagan's budget cutting plan. It agreed to offer \$14 million for the space station program in fiscal year 1984 with another \$14 million for fiscal year 1985, which were much fewer than NASA's need of \$63 million and \$123 million (McCurdy 1990, 127). Despondently, NASA had to compromise on OMB's offer if it wants to get the space station program approved.

President Reagan announced his approval for the space station program in the State of the Union Address on 25 January 1984. For President Reagan, his approval for the space station program was a political strategy, not a scientific endeavor (Lambright and Schaefer 2004, 7). The space station program and the Space Defense Initiative (SDI) were two fists of US Cold War strategy of using grand space application programs to develop US technological advantage, consolidate US leadership in the democratic alliance, and force the USSR economy to collapse. That is, President Reagan attempted to bankrupt the USSR by the SDI (escalating arms race) and the space station program (accelerating space race) (Krige et al. 2000, 608-609; Launius 2002, 15-16; Sheehan 2007, 177; Butrica 2008, 126-127).

In the late 1980s, however, the USSR was seemingly defeated, and the Cold War confrontation was fading. President Reagan could not obtain equivalent political support that President Kennedy enjoyed. Congress would not approve two grand space application programs simultaneously. Besides, the main reasons of building the space station were not economic or scientific, but were subjected to political and prestige considerations. For example, the space station would consolidate US defense posture and demonstrate US ability to control space, enhance international respect for US industrial strength, prove US ability to conduct large-scale programs, and strengthen domestic and international prestige of the US leadership (NASA 1983, 1, 20; Logsdon 2007, 101-102). All these benefits were non-economic and could not be assessed quantitatively. They were not sufficient to justify the space station for budget-minded Congress.

As a result, the second major obstacle of the space station program was congressional intervention. NASA faced continuous pressure from Congress to redefine the functions of the space station in order to reduce the money required. This led to a ceaseless redesign cycle and an inferior version of the space station. The congressional intervention, as Sadeh (2002a, 134) argues, "contributed to prolonged

development cycles and to cost overruns that are an endemic part of the problems facing the International Space Station.”

The third major obstacle came from the Department of Defense (DOD). The DOD opposed the space station program because it would divvy many resources that were allocated originally to military space programs. Therefore, NASA had to identify some advantages the DOD could gain from using the space station. However, the DOD did not endorse the space station program because it identified no benefit from using the space station. Besides, the DOD learned the impossibility of carrying out military missions on a system not run by its own control after the 1986 Space Shuttle Challenger accident (McCurdy 1990, 134).⁹

NASA’s incremental budget strategy suffered a bitter failure at the time. Without proper sums of funds, the space station program was difficult to be implemented. NASA had to compromise on the less satisfied version of space station because NASA would get nothing at all if refused it. Facing the shortage of committed budget, NASA continued to direct funds from its other programs into the space station (McCurdy 1990, 123). Now NASA could only rely on international participation to salvage the ill-fated space station program because it would disperse the costs and symbolize US superiority and leadership, and it was time to put this issue and its feasibility in broad discussion.

The Openness to International Participation

The discussion of international participation proceeded simultaneously with the concept coordination of the space station program. President Reagan and NASA inclined to invite competent international partners, while the DOD vehemently opposed such a strategy. President Reagan regarded the space station program as a critical component of US Cold War strategy and a proper medium to propagandize US leadership and superiority through international cooperation (Logsdon 2005). For NASA, international participation would disperse the colossal costs, acquire valuable foreign resources, and seemed to be a proper strategy to make the space station program more acceptable to Congress. The DOD opposed this strategy with the fear that the US technologies might leak through international cooperation to foreign partners, or via foreign partners to other antagonistic actors, therefore threatening US competitiveness and security.

Taking the DOD’s concern into consideration, NASA assured that the foreign

⁹ During the development of the Space Shuttle, the US planned to abandon its expendable launch vehicles and designated the Space Shuttle as the only launch vehicle for its military, commercial, and scientific payloads. After the Challenger accident, the Space Shuttle fleet was grounded for investigation, which made the DOD unable to carry out its military missions. The US then turned back to upgrade its obsolete expendable launch vehicles, and adopted a “two-track” launcher policy.

partners would be prudently selected under the criteria that they were competent to contribute to the program without any transfer of technology and funds (Pedersen 1982), and the space station program, despite an international endeavor, would be US-led and US-first (Lambright and Schaefer 2004, 7). This assurance was one of the factors that caused the crises during international cooperation. The DOD eventually decided not to take part in the space station program not only because it could not find any value of using the station, but also because of the climate of distrust in NASA's capability to satisfy DOD's requirements. As a result, the strategy of international participation was confirmed with the disappearance of its major opponent.

The US was reluctant to provide sensitive technologies. Therefore, it demands potential foreign partners for possessing contributive technological capabilities. Several space-faring states proposed their interests in participation. However, only Europe, Canada, and Japan were selected. They declared their political commitments to cooperation respectively in January, March, and April 1985. The US signed an IGA and bilateral Memorandum of Understanding (MOU) with the three foreign partners in 1988. President Reagan coded the program as Space Station Freedom for the symbol of US leadership in the "free world" cooperation.

The Space Station Freedom was US-dominated program to enhance US prestige and leadership. To wit, international cooperation in the Space Station Freedom was controlled by the US, based on US rational cost-effective calculations of strategic interests (Stuart 2009, 13). To achieve these goals, the US still revealed conspicuous concern on the fear that the involvement of these foreign partners would granted them advanced technological capabilities detrimental to the US, both in terms of national security and economic competitiveness (Lambright and Schaefer 2004, 8). As a result, the US demanded in the 1988 IGA for clear managerial interface, no transfer of funds and technology, and its decisive opinion on the station design.

Besides, technology transfer to these partners (and allies of the US) was not only prevented from careful selection of foreign partners, but also from the exclusion of industrial actors during international negotiations. Transnational industrial contacts are the most likely source of technology transfer (Pedersen 1982). Therefore, the US negotiated directly with foreign governments rather than through the track of industry-to-industry. Such practice evidently indicates that space-faring states are principal and decisive actors in space application programs. Private companies are competitors and receivers of governmental contracts and subsidies.

Russia's role changed drastically after the end of the Cold War. The US perceived the benefits of incorporating Russian technology of human space habitation into Space Station Freedom. Russia also recognized the necessity of pooling its effort with the US in order to save its space program under economic predicaments. There

were three phases to bring Russia on board the Space Station Freedom. The first phase was the 1993-1998 Shuttle-Mir program. The second phase was the connection of Russian Zarya (Functional Cargo Block) and Zvesda (Mir-2) modules with US Unity module after 1998 as the core complex of the ISS. The third phase was the attachment of other foreign partners' modules.

The decision of incorporating Russia derived primarily from US strategic self-interest considerations. First, the US wanted to attract Russian scientists and engineers to devote in US-led cooperation rather than selling their knowledge to other states. Second, the US tried to absorb Russian resources in US-led programs to prevent these crucial resources from flowing to enemies for antagonistic use. Third, the US sought to bind Russia with international non-proliferation agreement on ballistic missiles and nuclear technology, and thereby demilitarize Russian high technology sector. Fourth, the US coveted the technology of Russian Mir space station and tried to induce a transfer from Russia. Fifth, the US preferred a strategic alliance with Russia, in exchange for providing funds to revive Russian space programs and helping Russia consolidate its nascent democracy and transform to market economy (Sagan 1994, 222; Pasco and Jourdain 2002, 333; Harland and Catchpole 2002, 163-176; Lambright and Schaefer 2004, 10-11; Sadeh 2004, 185-186; Sheehan 2007, 179-181; Johnson 2007, 181). To fulfill these policy preferences, the US departed from its traditional guideline for international space cooperation. The US government transferred NASA's funds to Russia in exchange with Russian space station technology. Russia was also involved in the critical path assembly on which other partners depended to carry out their contributions to the ISS (Sadeh 2002b, 299).

Although the Russian participation was not a significant issue in the congressional debate, it was critical for US grand strategy, and gave the President a reason to endorse the ISS program (Lambright 2005, 198). These strategic interests outweighed the risks of security- and economic-sensitive technology transfer associated with Russia's participation (NASA Advisory Council 1998; Yakovenko 1999, 86; Lambright and Schaefer 2004, 13). Although the US-Russian strategic alliance could be challenged, they had to depend on each other to construct the station (NASA Aerospace Safety Advisory Panel 2009, 3). The US-Russian functional interdependence was formalized in the 1998 IGA and MOU (Sadeh 2002b, 283), which shaped another factor that destabilized the ISS cooperation.

3.1.2. European Rumination of US Invitation: Vigilant Calculation of Benefits and Risks

While calculating the costs and benefits of participating in the US-led space station program, Europe expressed various misgivings at the prospect of US

commitment to the space station program. To mention some, the US asymmetrical policy guideline aroused Europe's doubt about US willingness of mutual access¹⁰ to respective technologies. The possible military use of the space station and its connection with SDI might undermine public support within Europe. The accidents of Space Shuttle Challenger in 1986 and Columbia in 2003 put US capability of routine access to space into suspicion. US congressional intervention, unilateral redesign, and concomitant space station budget cut also seriously endangered the stability of international cooperation.

Besides, there were three vigilant opinions prevailed within Europe. First, Europe perceived US intention of absorbing European resources in US-controlled programs, thereby degraded European competitiveness against the US. Second, there was a debate between autonomy and engagement with the US as the most cost-effective way to promote European space technological capabilities. Third, the Spacelab lesson¹¹ cast European distrust in US sincerity for cooperation. The reason why Europe still decided to devote in the US-led space station program despite so many misgivings and asymmetric partnership was because Europe expected to benefit from utilizing the space station, and the benefits would exceed the costs it should pay.

European Early Reflections

Europe had adamantly demanded for the principle of mutual access to respective technologies since the inception of negotiation on the space station cooperation. There was always an asymmetric partnership between the US and Europe in space cooperation (Logsdon 1991). The US claimed that Europe would receive assured access to US space technologies during the cooperation. However, the US also argued that it would control the proceedings of the space station program to prevent unwarranted transfer of US technology to Europe (McCurdy 1990, 202). To wit, Europe could obtain US space technologies only when the US allowed it to gain.

The extent of US military involvement in the space station program also aroused serious European misgiving about space militarization. It was an open secret that the space station in low earth orbit could serve military reconnaissance and surveillance purposes, which was “a man-tended spy station flying above the PRC

¹⁰ The principle of mutual access refers to that each participant has the right to use all facilities on the space station, including those developed by other partners, under commonly agreed rules and payments. The authority of space station management might even rotate. Europe insisted that if they joined the space station program, it would have to be with equal access to the critical technology that kept the station running (McCurdy 1990: 100, 104).

¹¹ In order to encourage European participation in the post-Apollo program, the US suggested that they “might” purchase several of European Spacelabs. However, the US eventually purchased only one additional Spacelab as required in the original IGA. The US defection not only cost many European resources, but also disappointed Europe who saw international cooperation as a means to develop its own space technological capabilities (McCurdy 1990, 101-102; Russo 1999).

and the USSR” (McCurdy 1990, 132). When perceiving that NASA was trying to enlist US DOD’s support, Europe argued that the same restriction on European contribution to the Space Shuttle (because the Space Shuttle was also used for military missions) could happen on the space station program if the US DOD was on board. The space station might be used to test weapons in space, and it might even become a target of military attack. If these misgivings turn into reality, they would devastate public support for European civilian space programs (Pedersen 1982; McCurdy 1990, 105)

The US always assured its partners that all activities on the space station will be civilian and funded from NASA’s budget. European misgiving about space militarization was eventually somewhat alleviated with the DOD’s detachment from the space station program. In fact, like the Space Shuttle, the space station would be available for both civilian and military users. Military users could pay for utilizing the space station if they need. In order to mitigate European anxiety, the US guaranteed that if the station involves military activities, they would be restrained to peaceful and non-aggressive purposes (e.g., reconnaissance and communications) (Pedersen 1982; NASA 1984).

Nevertheless, the accidents of Space Shuttle Challenger in 1986 and Columbia in 2003 smashed European confidence in US ability to launch European payloads to the space station. Besides, the eleven times of program redesign from 1984 to 1989 and continuous budget cut not only wasted enormous European resources, but also alarmed Europe about US tottering commitment. European space budget was far less than US one. Europe was afraid that the money spent on the US-led space station program would be as the money spent on Spacelab, which had impeded the development of European space technological capabilities (McCurdy 1990, 104). Besides, Europe saw clearly US attempt of diffusing European resources by involving Europe in US-controlled space programs. For Europe, accepting the US invitation implied that a significant amount of its resources would flow into the program in favor of the US (Logsdon 2005, 26). As Bortzmayer (1984, 26) argues, “any substantial European involvement in a US-led space station program would absorb so much of the space budget that Europe would forfeit the ability to create a similar but independent capability.” There was a solemn debate within Europe over whether to engage in the US-led space station program. Europe had to calculate how much it could gain from cooperation against going alone. As a response to US invitation, Europe examined the program requirements to determine whether cooperation with the US is the most cost-effective strategy (Logsdon 2005, 29).

After President Reagan declared his approval for international cooperation, NASA emphasized that Europe had to decide soon on whether or not it wishes to

participate so as to be fully integrated into the phase B studies scheduled in early 1985 (Dickson 1984, 1273). West Germany and Italy proposed that the Columbus laboratory module to be considered as the European contribution to the space station. The European Space Agency (ESA) Council approved this proposal in January 1985 to stay abreast of US schedule. The European Columbus module was a critical step to achieve European autonomous capability in human space habitation, just like European Ariane launcher in the field of space transportation.

European industry was ready to support the Columbus module. However, whether Columbus could receive sufficient political and financial commitment depended ultimately upon the individual European states to decide the extent they wanted to invest (Logsdon 2005, 32). This practice again indicates that states are the major actors in space issue area. Governmental policies and subsidies have great influence on private companies and industries.

European Reflections after Russia Stepped In

European misgiving about Russian involvement in the ISS program came primarily from Russia's free-falling economy in the 1990s. What made the situation worse was Russia's role in the critical path of ISS assembly. The problems of Russia's stumbling economy were much worse than the other ISS partners supposed. Russia was even at the brink of withdrawing from the ISS program because of its economic difficulties. Russia's economic problem led to a vacuum of governmental funding to its aerospace industry. The compound of domestic funding vacuum and poor management of foreign funds alarmed Europe of Russia's inability to fulfill its obligation to the ISS (Lambakis 2001, 159).

Russia's delay of providing the core module (i.e., Zvesda and Zarya) inevitably postponed the follow-on launch of other partners' modules, including those of the US. The program costs were soaring consequently. The quickest and cheapest solution was to offer Russia the money it required, but that was politically unacceptable to US Congress. NASA had tried to pay Russia \$20 million in advance for continuous use of Mir during 1998, but Russia's inability had been clearly perceived. US Congress began to deepen its intervention on the ISS costs (Harland and Catchpole 2002, 195).

US domestic politics and budgetary stringency necessitated the redesign of the space station. This also led to European frustration. Europe had planned to cancel its partnership in the Space Station Freedom because it was tired of US unilateral program redesigns during 1988 and 1993. NASA's plan changed every year when Congress modified it, making the US an unreliable partner (Harvey 2003, 312). Intriguingly, Europe turned to Russia in 1993 to discuss the possibility of transforming the Russian Mir-2 into a Russo-European space station without US

participation. Europe and Russia eventually did not reach an agreement on this joint plan because of Russia's economic problems and inability to meet the requirements. Had the Russo-European space station come into being, the US space station would have disintegrated, left Russia and Europe operating the world's only space station, and surpassing the US in the field of human space habitation (Harvey 2003, 314; Sheehan 2007, 180).

Another European misgiving was the effort duplication of Europe and Russia. After the 1995 Toulouse ESA Council confirming European interest in the new ISS (with Russia's participation), Europe decided to build the Automated Transfer Vehicle (ATV) as an Ariane-V upper stage to deliver cargo and to replenish the Russian Service Module's propellant. The European ATV was thrown into doubt by Russia's announcement that it would develop a similar logistics vehicle. Europe argued that the ATV could be adapted to the US Crew Transfer Vehicle whose function would supersede Russia's Soyuz as the lifeboat of the ISS (Harland and Catchpole 2002, 190-191). At the time, Russian economic problems not only alarmed the US that it should not deepen its dependence on Russia, but also prompted the US to consider European offer of logistics vehicles (Harland and Catchpole 2002, 199).

Russia dropped its plan a few months later because the US supported Europe. The US supported Europe because the European ATV was regarded as "yet another means of reducing reliance on Russia" (Harland and Catchpole 2002, 191; Harvey 2003, 314-315). Contrary to Russia's participation that had rescued the program from US domestic political morass in 1993, the inability of Russia throughout the 1990s become the greatest obstacle to the ISS assembly (Harland and Catchpole 2002, 197; Lambright and Schaefer 2004, 12).

3.1.3. Crises during Cooperation

International cooperation in the ISS program was a wrestling between colossal costs and expected geopolitical interests. Besides, the ISS program experienced many crises because it was a political program rather than scientific cooperation. Developing a space station capable of permanent human habitation was not only extremely complicated and expensive, but also raised several security and commercial interest concerns of the US, Europe, and Russia. These self-interest concerns led to instability of international cooperation in the ISS program.

US solicitude over technology transfer shrouded the entire ISS program, which implied that the ISS cooperation was a politics of technology rather than a technological challenge. The US traditional guidelines of prohibiting technology transfer in international cooperation stood firmly in the ISS program, which was camouflaged by US statement of sincere cooperation. In fact, the US practice

reaffirmed its traditional conservative mindset in the past (McCurdy 1990, 103).

The US was always concerned whether Europe, Russia, and other partners were competent to build reliable hardware for the ISS. The US also worried that international cooperation would stimulate foreign partners to develop technological capabilities that might compete with the US (Logsdon 2005, 2). The US DOD, Department of Commerce, Central Intelligence Agency, Department of State, and Arms Control and Disarmament Agency all had interests in protecting US technology and were less willing to consider foreign involvement in the ISS program (McCurdy 1990, 104). The US DOD even eloquently opposed acceding to multilateral decision-making, and refused the concept of equal partnership to displace US leadership in the ISS program (Krige et al. 2000, 658).

The ISS program also suffered from US congressional reservation that to appropriate only enough money year by year and to reconsider the rationale of the program when political circumstances changed (McCurdy 1990, 233). The US congressional interventions led to many times of redesign and seriously undermined European interests concerning the waste of invested resources. The ISS program also underwent several times of budget cut and termination attempts by US Congress primarily because of the problems associated with Russian economic inability and NASA's mismanagement that led to cost overruns (Johnson-Freese 2002, 82; Lambright and Schaefer 2004, 2). According to Logsdon (1991, 45), Europe and other foreign partners reacted to US congressional intervention and perennial changes in the core module of the ISS "with warnings of the collapse of the partnership, not an expressed willingness to work together to salvage the cooperative undertaking."

The ISS program was twice in turmoil in 1986 and 2003 due to the accidents of Space Shuttle Challenger and Columbia, which were beyond the control of ISS program managers. These accidents were accompanied by reassessments of the Space Shuttle reliability and the ISS prospects, and put NASA's readiness to take the "next logical step" into question (McCurdy 1990, 224; Madison and McCurdy 1999, 214). Europe's distrust of US reliability to assure European access to space reaffirmed European (particularly France) resolution to pursue autonomy. For example, ESA finally decided to scale down the European Columbus laboratory to be launched on its Ariane-V launcher rather than the US Space Shuttle. Even before the Space Shuttle Challenger accident, France had cooperated with the USSR in 1982 to fly a French astronaut aboard the Salyut space station. Europe was increasingly arguing to achieve autonomy in all fields of space activities, including human space habitation. The debate between European autonomy and intimate engagement with the US was one of the factors that destabilized the ISS cooperation (Logsdon 2005, 30).

Another event led to crisis was US refusal of Europe's request for an arbitration

mechanism (Krige et al. 2000, 653, 656). Europe insisted on the need, in the name of Western democracies, of an arbitration mechanism for dispute settlement. Europe regarded compulsory arbitration not only as an instrument for settling disputes, but also as an inducement to find congenial solutions even before any resort to arbitration. Europe's rationale was to establish a proper legal recourse against any redesign of the ISS that undermined European interests. However, the US placed its own interests above shared values and refused the Europe's request in order to protect its absolute freedom of space activities from external constraints.

Moreover, in order to incorporate Russia, the US departed from its strict policy guideline (i.e., no transfer of funds) for space cooperation. In 1993, the NASA-Russian Protocol on Human Spaceflight Cooperation stated that NASA would compensate Russia's services and hardware in the Shuttle-Mir program and the ISS program (NASA 1993). These developments resulted in the signature of NASA-NPO Energiya contract in December 1993 in which the US agreed to transfer \$100 million of NASA's funds in fiscal year 1994 for Russia's services during the phase one of the ISS program. An additional amount of \$300 million of NASA's funds would be transferred to Russia for its services in the phase one and phase two activities of the ISS program (White House 1992; 1993; NASA 1992; Sadeh 2004, 184).

Another example of US flexibility in technology transfer with Russia was the US-Russian Contract for Supplies and Services Relating to Mir and the International Space Station. NASA's international cooperative activities were under the regulation of US export control regimes (i.e., International Traffic in Arms Regulations and Export Administration Regulations). The exchange of ISS hardware, software and technical data between the US and its foreign partners were in the scope of these regulations. However, in order to implement the US-Russian contract for supply and service, NASA requested and received approval for modifications of the clauses regarding federal acquisitions and technology transfer, primarily because Russia, as a sovereign state, did not want US domestic export control laws to stipulate its space activities (Sadeh 2004, 180-181). However, the US strictly prohibited transfer of technology and funds to Europe in the same program.

President Clinton directed NASA to redesign the core configuration of the ISS again unilaterally in order to integrate Russian hardware, regardless of other partners' legitimate interests. The US-Russian agreement for the integration was signed in September 1993. The first meeting of the US, Europe, Japan and Canada to discuss the new ISS program was held in November 1993, which was well after the US and Russia had decided the new design. Europe, Japan, and Canada played very little role in this "superpower" negotiation (Harvey 2003, 314). In December 1993, Europe, Japan, and Canada agreed Russia's participation because they had invested too much

in the program. There followed another four years of negotiations to revise the 1988 IGA to accommodate Russia. The new IGA was signed in January 1998 (Harvey 2003, 315; Logsdon 2005, 42).

The ISS was a symbol of post-Cold War US-Russian cooperation. US funds transfer successfully stopped Russian technology transfer to India. However, Russian later violated the non-proliferation agreement by transferring missile and nuclear technology to Iran regardless of US complaints, which led to the pass of the Iran, Syria, and North Korea Non-Proliferation Act (a US domestic law) in 2000 to address Russian proliferation problem. This act banned the US to make ISS-related payments to Russian technology unless Russia stopped the proliferation of weapons of mass destruction, missile technology, and other advanced military systems to any of the mentioned states. After the 2003 Columbia accident, the Space Shuttle fleet was grounded for investigation. The Russian Soyuz spacecraft became the only vehicle to transport astronauts to and from the ISS (Johnson 2007, 181). However, NASA was not allowed to pay for Russian Soyuz service because of the 2000 Act (Lambright and Schaefer 2004, 16; Squassoni and Smith 2005; Sheehan 2007, 181; Sabathier et al. 2008; Johnson-Freese 2009, 107). The suspended US funds not only impeded Russia to fulfill its obligation, but also undermined Europe's interests in the ISS program.

The planned retirement of Space Shuttle in 2010 complicated the dilemma. The new US launcher and crew vehicle, Ares-I and Orion, was scheduled originally to be operational after 2014, and cancelled recently by President Obama. It implies that the US cannot conduct ISS missions unless relying on Russian Soyuz spacecraft. Europe was aware of the constraints, and worked with Russia to establish a Soyuz launch facility in its spaceport in French Guiana (Centre Spatial Guyannais; CSG), which inaugurates in 2010. With this facility, Europe is no longer dependent on the US for human access to the ISS (Abbey and Lane 2005, 18-19). Besides, the crew-escape capability was of serious concern. The ISS infrastructure will be enlarged, and habitation crew will expand to six or more. However, the only Crew Return Vehicle, Soyuz, can provide escape capability only for a crew of three. The US requires additional Soyuz spacecraft, but the 2000 Act prohibits the US from funding Russia for Soyuz services (Lambright and Schaefer 2004, 16-19; Squassoni and Smith 2005; Sabathier et al. 2008).

Unlike the problem of technology transfer to India, the US and Russia could not reach an agreement in the case of Iran, primarily because non-proliferation and other security concerns gained higher priority in the wake of the terrorist attacks on 11 September 2001 (Lambright and Schaefer 2004, 18). Only after a great deal of NASA and White House lobbying, accompanied with the Columbia accident, according to Johnson-Freese (2009, 107), did "Congress waived the ban [in 2005] to allow NASA

to enter into a \$719 million contract with the Russians for use of the Soyuz as a shuttle to the ISS through 2011.” Nevertheless, US reliance on Russian Soyuz services renders Russia a crucial role in the ISS operation and political advantage regarding technology transfer. In this way, according to Sagan (1994, 201), “space becomes once again, as it was at the height of the Cold War, an instrument of national strategic policy.”

3.1.4. Causal Mechanism of the Case

This case is inconsistent with realism in almost any version because the practice of the US, Europe, and Russia did not indicate obvious relative gains concerns. Their practice was similar to those in trade-related issue, in which also competition and cooperation come together and we can hardly discern that states were clearly motivated by relative gains concerns. Neither is this case consistent with hegemonic stability theory, since the US was unable to dictate European and Russian behavior in the cooperation. On balance, this case is consistent with neoliberal institutionalism. All sides are in competition over space exploration. However, because of economic stress and budgetary stringency, they have to cooperate in order to achieve their respective objectives.

The interest configuration of the US, Europe, and Russia in the ISS cooperation is a mixed-motive situation. The US aimed to maintain space dominance, Europe tried to achieve autonomy and obtain advanced space technologies, and Russia expected US funds to support its own space programs. They need cooperation to achieve respective objectives. For the US, the survival of the ISS program depends on the continuous cooperation of foreign partners. Loss of any partners would shatter the entire program. For foreign partners, their political and public support of the ISS program depends on the continuation of the ISS as a joint effort (Kay 1994, 146; Stuart 2009, 18). The domestic and international crises might destabilize international cooperation, but they could not annihilate states’ willingness to build the ISS because of its salient springboard implication to control lunar and solar space.

The issue of this case was not competition. The key factor that led to the variation of cooperation pattern is whether they calculated their gains in comparison with others. The US calculated transferring its money in exchange for the relatively advanced hardware of Russian Mir space station as a cost-effective strategy to satisfy its own interests, while transferring its technologies or funds to Europe as undermining its technological superiority vis-à-vis its ally. As a result, the US conducted substantial exchange with Russia and prevent it in the cooperation with Europe. Besides, this case clearly shows the influence of domestic structure on US position. The whole issue comes up because of US budgetary constraints.

3.2. US-European and Sino-European Cooperation in the Galileo Satellite Navigation Program

This case study investigates the shift of US and European strategies from competition to cooperation between their dual-use satellite navigation systems under changing structural situation as well as US misgivings about the PRC's participation in the Galileo program. The interaction between Europe and the US in the field of satellite navigation is a crucial case of international politics because critical shift of strategies from competition to cooperation occurred in its course. This within-case variation of European and US space strategies offers a good opportunity to conduct an effective examination of competing IR theories on their validity to explain international cooperation problem.

This case study proceeds in three parts. The first parts illustrate the attributes of European Galileo satellite navigation system, thereby unfolds its sensitivity to the international and domestic structure. The second part elaborates the shift of US and European strategies in the field of satellite navigation from competition to cooperation, as well as the implications of the PRC's involvement. The third part evaluates the empirical validity of IR theories with the research findings.

3.2.1. European Galileo Satellite Navigation System: Rising Demand for Autonomous Security Assurance

The European Galileo satellite navigation system is developed and controlled by civilian agencies, but comes into being mainly from rising demands for autonomous security assurance, and in fact can be used for military purposes. The initiation of European Galileo satellite navigation system derives from an amalgamation of two major considerations. The first is Europe's perception of the strategic significance of space technological capability along with European impotence in the field of satellite navigation. The second is Europe's misgiving about its overdependence on US technologies.

The 1999 NATO Kosovo campaign made it clear for Europe that possessing advanced space technological capabilities (especially satellite navigation capability) is the prerequisite for its Common Foreign and Security Policy and European Security and Defense Policy (European Commission 2002; Braunschvig et al. 2003, 159; Lungu 2004, 377). The 2003 Iraq War showed how satellites replace lasers as guidance of weapons such as the Joint Direct Attack Munition (Snyder et al. 2007, 46; Whalen 2007, 296; Sturdevant 2007, 334). The role of satellite systems for positioning, surveillance, and communication has been proved crucial in modern warfare. Europe was convinced that it should develop its own satellite navigation system as a security assurance against the possible US denial of its access to GPS

signals (Lambakis 2001, 152; Booker and North 2005, 550; Johnson-Freese 2009, 6, 136-137).

The European Commission (EC) and the ESA co-initiated the Galileo program. ESA proposed the idea of an independent satellite navigation system in the mid-1990s, when European users were still extensively dependent on GPS services. Europe believed that developing an independent navigation satellite system could provide experience in cutting-edge technologies, reduce European overdependence on the US, facilitate EC-ESA collaboration, and be commercially profitable (Harvey 2003, 347).

The EC (1998; 1999) declared the feasibility of an independent navigation satellite system, and proposed a refined version of Galileo with its competitiveness in global satellite navigation market. The European Council (1999) then decided that EC could move ahead with ESA to establish the Galileo system. At the 2001 ESA Council meeting held in Edinburgh, almost all member states (except Britain and Denmark) supported the Galileo program. At the EU level, the Council of Transport Ministers approved the Galileo program on 26 March 2002.¹² Eventually, in May 2003, the Galileo program with its constellation of thirty satellites and ground infrastructures was authorized for construction.

Galileo was the first European large-scale space application program organized under the aegis of EU, and was the first time that Europe could control a real autonomous space system with considerable strategic values. The inside-Europe discussion over the merits of Galileo system also confirmed the doctrine of autonomy that underlies EU space policy. Although European users already had access to US GPS, there was still misgiving that the US would block such access unilaterally. Similar considerations triggered the development of European Ariane launcher in the 1970s. To survive future security threat and economic competition, Europe needs space systems under its own control on a permanent basis (Sheehan 2007, 88).

The Galileo system represents European determination to advance its space technological capabilities for commercial competitiveness and autonomous security management. In addition to expected revenues and a broad range of new industries being spawned, Galileo system also provides Europe with greater flexibility in foreign policy, particularly in security and defense issue area (Ashkenazi 2000, 186; Lindström and Gasparini 2003, 17-18). However, it is necessary to camouflage the military purposes of Galileo system because ESA, a major partner in this program, is prohibited from engaging in military activities, though the availability of Galileo system for military users had been confirmed by the EC (2002) that “Galileo will also give the EU a military capability.”¹³

¹² 2420th Council meeting, “Transport and Telecommunications,” Brussels, 25-26 March 2002.

¹³ Most of space technologies contain dual-use characteristics, particularly navigation satellite systems.

The pace of US GPS-III upgrade program is too slow; therefore invalidates the US claim that a modernized GPS would make Galileo unnecessary (Lewis 2004a, 2). The EC and the ESA embarked on Galileo system at the beginning of the 2000s with a pragmatic division of labor. The EC is responsible for Galileo's political and administrative affairs such as aggregating political support, ensuring the availability and continuity of operational services, as well as coordination, implementation, and monitoring of Galileo properties. ESA is responsible for Galileo's technical affairs such as design, procurement, and development of the system's components (Secara and Bruston 2009, 212, 214; Mazurelle et al. 2009, 15).

The four Galileo In-Orbit Validation Experiment satellites were launched in 2008, and the thirty-satellite constellation is scheduled to be complete by 2010 (Johnson 2007, 179; Whalen 2007, 296). However, the contracts for the Galileo full operational capability phase were just signed on 26 January 2010 to begin the building of Galileo operational infrastructure. The German company OHB-System AG was assigned to manufacture the first batch of fourteen Galileo operational satellites with the delivery of the first satellite in July 2012. The progress is years later than original schedule.

Europe has welcomed non-European participation in its Galileo program, among which Russia and the PRC plays a significant role. The Galileo satellite launch was assigned to Arianespace's five Soyuz launchers with an upgraded Fregat upper stage that to be launched from CSG, each launch will place two Galileo satellites in their final orbit. The critical Soyuz launch facility in CSG and substantial PRC participation making Galileo an international venture to counter US dominance in the field of satellite navigation.

3.2.2. Strategy Shift in Transatlantic Competition and the PRC's Participation

This subsection proceeds in two parts. The first part discusses European and US competition practice, which evinces obvious contradictory interests between them. The second part elaborates the changes of structural situation and the PRC's involvement that triggered the modification of European and US strategies.

Transatlantic Competition Phase

Before the initiation of European Galileo program, the US maintained dominance in the field of satellite navigation, and Europe was willing to depend on US GPS services. However, in 1990, the US DOD unilaterally installed an artificial error called Selective Availability (SA) into GPS civilian-use signal to deteriorate its

The ESA is not allowed to involve in military programs, so it did not mention Galileo's military applicability, which was though an open secret.

accuracy for fear of potential antagonistic use.¹⁴ Such unilateral installation not only undermined the interests of worldwide civilian GPS users, but also discredited US reliability of navigation data provision. The unreliable US data provision and increasing European space technological capabilities made US GPS no longer a beneficial public good for Europe. Europe calculated that developing an autonomous satellite navigation capability is more cost-effective to satisfy its security needs than depending on GPS. To wit, the Galileo program reemphasizes European space strategy of developing independent technological capabilities (i.e., achieve maximum feasible freedom and develop full capabilities) in areas with commercial and security importance (Van Scherpenberg 2008, 148).

The US turned off SA on 1 May 2000 to obviate European Galileo program or at least slow down its development, as well as to make GPS more responsive to worldwide users and to convince other space-faring states not to build their own navigation satellite systems (Lewis 2004a, 3; Beidleman 2005, 144-145; Handberg 2007, 366). However, the US was not willing to relinquish the right to degrade or shut off civilian-use signal (Evan and Hays 2006, 106). In December 2001, the US Deputy Secretary of Defense Paul Wolfowitz even argued that in the interests of NATO, Europe has to make sure that Galileo signals could be jammed by US forces if Galileo is to be developed. This US request exacerbated European grievance against US unilateralism (Lindström and Gasparini 2003, 23; Lewis 2004a, 5; North 2004). Europe regarded the US request as an excuse to protect US interests as well as an infringement of European sovereignty. US lack of flexibility in policy options led to futile US effort to undercut European determination to develop the Galileo system.

The notion of assured access to satellite navigation data was a strong motivator for Europe to develop the Galileo system (Lindström and Gasparini 2003, 18). It aimed first at breaking GPS monopoly, and then profiting from the interest of buyers in a major non-US supplier of services and equipment (Lungu 2004, 382). Galileo represents Europe's desire for political, technological, and security independence from the US (Kupchan 2002, 149-150; Beidleman 2005). In January 1998, the EC (1998) declared that satellite navigation system represents Europe's strategic position

¹⁴ The military-use signal, Precision code (P-code), provides users with accuracies of 21 meters horizontally and 29 meters vertically. Under ideal conditions, the civilian-use signal, Coarse/Acquisition code (C/A-code), can provide an accuracy of 20-30 meters horizontally, which is very close to the military-use signal. The P-code is transmitted using the L1 and L2 bands, while the C/A-code is limited to the L1 band, which is less accurate and easily degraded by SA. Therefore, SA can 'wipe out' the C/A-code without detriment to the P-code. The US DOD installs SA to degrade the C/A-code signal to the accuracies of 100 meters horizontally and 140 meters vertically for the purpose of reducing potential damage of hostile use. SA was activated on 25 March 1990, deactivated during August 1990 to 1 July 1991 for the alliance use in the Persian Gulf War, and finally terminated on 1 May 2000 (Pace et al. 1995, 1, 264-265; Lachow 1995, 126-129; Pace 1996, 266-267; Lambakis 2001, 35-36; Spencer et al. 2003, 3; Braunschvig et al. 2003, 158; Lewis 2004a, 3; Handberg 2007, 365; Sturdevant 2007, 332; Bolton 2009, 191).

in the world, and that European dependence on foreign controlled system would raise serious sovereignty and security problems. The Galileo system could be a European strategic asset independent of the US, and therefore protect Europe from the US unilateral degradation or denial of GPS services (Beidleman 2005, 119).

An independent European navigation satellite system fomented transatlantic discord ever since because of its dual-use characteristic. After Airbus and Ariane launcher, Galileo is the third large-scale program aims at relieving European overdependence on US technologies (Lungu 2004, 377; Lewis 2004a, 1). The US has an interest in promoting advantages and performance of GPS as international public good to maintain its space technological leadership and prestige (Lembke 2001, 4-5). The European Galileo system was designed as an alternative to US GPS, because Europe was reluctant to cede its airspace sovereignty and security assurance to unreliable US GPS data provision (Lachow 1995, 141-142; Braunschvig et al. 2003, 160; Trachtenberg 2005, 228). The US regarded the Galileo system as not only a dissenter in transatlantic alliance, but also a challenge to US global security strategy.

Nowadays, GPS is integrated into every facet of US military operations. Since Galileo signals may interfere with GPS ones according to Galileo's original design, the US military security interests is therefore threatened. For the US, the European Galileo system not only impedes US space control, but also invalidates US effort to deny navigation data to enemies (Beidleman 2005, 120, 137). Europe perceived US practice as chauvinistic and mercantilistic. The US understood this, which was unequivocally stated in an official report that "the success of GPS will be compromised if the US approach to GPS technology is perceived as chauvinistic or mercantilistic by foreign interests."¹⁵ However, the US was unwilling to accept an increasing competitive transatlantic relationship initiated by Europe, while European officials declared that "Galileo is designed for a Europe that did not have an ally across the Atlantic" (Lewis 2004a, 2).

It is important to discuss PRC's substantial participation in the Galileo program. The EU and the PRC signed the Sino-European Galileo Plan Technology Cooperation Agreement in 2003 with the PRC contribution of about €200 million and technological exchange in the program (Johnson-Fresse and Erickson 2006). According to this agreement, the PRC would be involved in substantial development of the Galileo program such as R&D, manufacturing, and other technical applications (Casarini 2006, 26). The Sino-European cooperation facilitated Europe to enter PRC's aerospace sector, while the PRC acquired critical technologies and know-how to

¹⁵ National Academy of Public Administration and National Research Council, "The Global Positioning System: Charting the Future," Summary Report for the Congress of the United States and the Department of Defense, May 1995. Full text available at <http://www.navcen.uscg.gov/pubs/gps/gpsfuture/GPSfuture.doc>.

improve its rudimentary Beidou navigation satellite system (Casarini 2006, 27). The first three Beidou satellite were launched during 2000 and 2003. However, its capability is relatively limited only to support the intercontinental ballistic missile force of the People's Liberation Army (Johnson 2007, 178).

This Sino-European substantial cooperation “entails a strong strategic component which will have far-reaching consequences on future Sino-European political relations” (Casarini 2006, 26-27). The US considered the Sino-European cooperation as a betrayal, primarily because it breached US strategy of technological containment against the PRC. Since the fast-rising PRC was one of major potential military rivals of the US, the Sino-European strategic partnership in the Galileo program also alarmed the US about the impacts on its security (Booker and North 2005, 550; Handberg 2007, 366).

On the other hand, the EU was happy to allow the PRC to buy a 20% share of Galileo with merely €200 million because this exchange would enable European arms manufacturers to sell the PRC the weapons and equipment confined only through Galileo control. This was why France and Germany were eager to terminate arms embargo to the PRC. After the 2003 Iraq War, several European states that possess strong antagonism toward US unilateralism were looking to the PRC as one of their potential military allies (Booker and North 2005, 552; Casarini 2006, 31). In fact, the European arms embargo to the PRC became a symbolic rhetoric. The Sino-European exchange of funds and dual-use technologies is apparently under way (Van Scherpenberg 2008, 150). Europe views the Sino-European cooperation in the Galileo program as a means to struggle against US hegemony (Beidleman 2005, 129). The decision to involve the PRC in the large-scale strategic endeavor indicated that Europe did not view the PRC as a military threat or strategic competitor, but a suitable partner to extend the security dimension of its foreign policy (Casarini 2006, 27-28).

In sum, Europe regarded control over space-based strategic infrastructures as critical for its global competitiveness and influence. The Galileo program underscored Europe's desire for a mighty and vigorous voice in international affairs. Galileo would provide Europe with an unprecedented political leverage vis-à-vis the US (Lungu 2004, 381). Therefore, it is a strategically logical step for Europe to acquire autonomous capabilities of developing, launching, and operating satellites that perform global communication, positioning, and observation missions (ESA 2003; SPASEC 2005; Sheehan 2007, 89).

Cooperation Turn

During the keen competition between GPS and Galileo, four aspects of change in structural situation drove Europe and the US to reconsider the relationship between

their satellite navigation systems, and finally modified their competitive strategies to cooperative ones. The first aspect was post-September 11 security needs, which not only urged the US to contemplate the necessity of having a second navigation data source from its Europe to ensure its national security (Lembke 2001, 29), but also prompted Europe to weigh the cooperation with the US as a more effective security assurance. In order to effectively counter the threat of international terrorism, Europe and the US emphasize navigation data sharing that facilitates the “hunt-down” of terrorists. The US called for greater burden sharing by Europe in global security; however, it preferred Europe to be a subordinate rather than an equal partner in order to ensure its absolute freedom of action.

The second aspect was the shortage of Galileo program funding. It was decided that funding for the Galileo program would be gathered from a public-private partnership, named as the Joint Undertaking (European Council 2001; 2002). However, there was an undesirable gap between expected and virtual sums of money from private sector. The financial contribution of the private sector to the Galileo program has been discussed since 1999, but no single company was willing to commit large sums of money to such a risky system. Private companies were afraid that they spent enormous amounts of money with little return. This did not imply power shift from state to non-state actors. The question is how states induce investment from private companies. States still possess the authority of space policy-making that guides their space activities.

The EU did not build a congenial and reliable environment for private sector to invest, thereby made them argue that “European authorities should create a competitive service company (like Arianespace for Ariane launcher) in which manufacturers and operators would have control” (Lembke 2001, 11-14). In other words, European private sector was unwilling to invest substantially if the prospect of Galileo system remained obscure and the risk of reckless investment stayed high. This failed public-private partnership and the unpredicted shortage of funds forced Europe to look for non-European support from cooperation with the PRC, Russia, and other potential partners (e.g., Brazil, India, and Israel).

The third aspect was US misgiving about technology proliferation from Europe to the PRC. The PRC firmly supported Europe in this transatlantic dispute because it saw the participation in the Galileo program a significant step to multiply its own military power against US asymmetric satellite network prowess. The PRC has also expressed its interest in acquiring Galileo’s authorized service for military use (Lewis 2004a, 6-7; 2004b, 2). A study of the European Union Institute for Security Studies (Casarini 2006, 29; see also Jones 2007, 240-243) points out Galileo’s contribution to the modernization of PRC’s space program and military capabilities:

“The US is worried that China’s participation in the Galileo program will boost the People’s Liberation Army’s ability to acquire the expertise that allows armed forces to be integrated for today’s increasingly digital warfare, in particular the most advanced early-warning systems and recognition satellites that would put China in a position to counter Taiwanese arms systems imported from the US...The acquisition of space-guided missiles would certainly spearhead Chinese military strategic efforts to gain the upper hand over Taiwan. According to American critics of Galileo, China’s participation in the European satellite system will be a major setback to US efforts to limit China’s access to advanced space technology with potential military uses.”

The US considered cooperation with Europe because it tried to prevent unwanted technology proliferation to its adversaries (Beidleman 2005, 144). The goal of non-proliferation is an ingrained component of US global security strategy, which always urges the US to oppose independent or joint space application programs of other space-faring states lest undesirable technology proliferation occurs. The non-proliferation preference also fortifies US predisposition to prevent other states from acquiring or developing advanced technological capabilities, thereby intensifies European grievance against US monopolization (Lewis 2004a, 3).

It is widely recognized that the Sino-European cooperation in the Galileo program was a reaction to the neo-conservatism of the US in the past years. However, the US underestimated the determination of other space-faring states to make the development of independent space technological capabilities a policy priority (Lewis 2004a, 4). The US still pursued space control, dominance, and militarization, and adopted strict export control even during international space cooperation, thereby impelled Europe, the PRC, and other space-faring states to cooperate themselves (Casarini 2006, 28). They will continuously invest in their independent or joint space application programs to gain international prestige and counter US monopoly. The relatively flexible and substantial international space cooperation without the US, along with the global proliferation of space technology, greatly facilitates other space-faring states such as the PRC and Europe to obtain the required technological capabilities to build independent satellite navigation systems without US support.

The US still adamantly insisted that Galileo technologies should not be disseminated, because rouge states, terrorists, or other hostile actors might use Galileo in antagonistic operation against the US. In order to prevent unwanted technology transfer and proliferation, the US had to enmesh Europe in an international management framework in which it has control. The Sino-European cooperation in the Galileo program entailed substantial transfer of European advanced space

technologies that contributed to upgrade PRC's military development and applications (Beidleman 2005, 143; Casarini 2006, 29). In turn, the PRC's substantial participation in the Galileo program provided Europe with additional leverage in transatlantic negotiations that compelled the US to concede (Beidleman 2005, 140).

The fourth aspect came from the pressures of vested commercial interests on Europe. Many merchant ships are European-owned and use US GPS to maintain smooth operation of global manufacturing and trade systems. Once the Galileo system is in operation, no one wants to install two different receivers with two different operating manuals, or to organize two different sets of training. This debate also arose in civilian airlines that they could not install two parallel systems at the same time. Some potential users of Galileo even argued that they would not use it unless the Galileo system is interoperable with GPS (Blanchard 2003, 95; Johnson 2007, 180).

The US also underscored that several European user communities already rely heavily on GPS and have ineradicable interests. Besides, a number of European companies have participated actively in the GPS sector and export their equipment and services around the world (Lembke 2001, 18). These commercial stakes compelled the Council of Transport Ministers to agree that Galileo "should in particular be interoperable with GPS and its successor systems through an EU-US agreement that should be negotiated as soon as possible."¹⁶

The interoperability between Galileo and GPS is not a technical problem, but a problem of legislative, regulatory, and authoritative compatibility. Started in 2001, the EU-US negotiation mainly focused on the intricate disputes over the distribution of signal frequencies. The Galileo public regulated service (PRS) code is an encrypted signal and is resistant to jamming and electronic interference. PRS is reserved for the public authorities responsible for civil protection, national security, and law enforcement that demand high accuracy and continuity (SPASEC 2005). At the 2000 World Radiocommunications Conference, the EC obtained the right under the regulation of the International Telecommunication Union to use the precise modulation of binary offset carrier, BOC(10,5),¹⁷ for PRS signal transmission. However, the military code (M-code) of US GPS-III also use BOC(10,5), which means that Galileo PRS code will share a portion of BOC(10,5) with GPS-III M-code, or even directly overlay on top of M-code, thereby lead to disastrous signal interference. Besides, it also means that the US would be unable to jam Galileo PRS signal without detriment to GPS-III M-code signal (Braunschvig et al. 2003, 161;

¹⁶ Council of European Transport Ministers Statement, 2420th Council Meeting, Brussels, 25-26 March 2002.

¹⁷ The modulation of M-code signal and originally planned PRS signal is a binary offset carrier signal with subcarrier frequency 10.23 MHz and spreading code rate of 5.115M bits per second, abbreviated as BOC(10,5) (Lindström and Gasparini 2003, 22; Falcone et al. 2006).

Beidleman 2005, 138; Bolton 2009, 198).

It is a worldwide principle that frequencies available for satellite navigation do not belong to a particular country or system. However, the US tried to occupy the more accurate modulation BOC(10,5) and asked Europe to use BOC(14,2), which is relatively less accurate and can not satisfy the need for Galileo performance. Again, the US request got nothing but deeper European grievance. The US then softened its position to announce that it would provide a more favorable term of export control on items like space-qualified clocks and radiation-shielded, and to share experience in managing large satellite constellations in exchange for Europe's concession to use BOC(14,2) (Beidleman 2005, 145).

Despite the US claim, Europe insisted on BOC(10,5) for PRS signal because of its resistance and robustness against jamming attempts as well as its potential to satisfy Galileo performance. Besides, by overlaying the PRS signal directly on the M-code, Europe could force the US to consult it before the US decides to jam Galileo signals. Among major European states, France remained the most steadfast on using BOC(10,5) for PRS signal because European weapons manufacture will be integrated into Galileo, and the more resistant and robust Galileo signals will generate considerable foreign interest in purchasing European weapon systems (Beidleman 2005, 138-139).

The PRC's participation further complicated transatlantic negotiations. The US regarded the strategic partnership between Europe and the PRC and the prospect of PRC's access to Galileo's data as a threat to its global security strategy (Beidleman 2005, 140). With the common objective of GPS-Galileo interoperability, the issues in transatlantic negotiations extended to the question that who would have the authority over the two systems in a presumable Taiwan Strait crisis (Bolton 2009, 200).

After three years of intensive negotiations, the US agreed not to control the future use and improvement of Galileo signal structures, in exchange for Europe's concession to use another less accurate international standard signal modulation, BOC(1,1), as a temporary protection of the stability of GPS-III M-code signal (Bolton 2009, 203-204). Europe and the US signed the Agreement on the Promotion, Provision and Use of Galileo and GPS Satellite-Based Navigation Systems and Related Applications in June 2004,¹⁸ in which confirmed radio frequency compatibility and system interoperability between GPS and Galileo to satisfy the

¹⁸ The EU and the US signed this agreement at the end of the Summit held in Ireland on 26 June 2004. The compatibility of radio frequency refers to "the assurance that one system will not cause interference that unacceptably degrades the stand-alone service that the other system provides." The interoperability at the user level refers to "a situation whereby a combined system receiver with a mix of multiple GPS or Galileo satellites in view can achieve position, navigation and timing solutions that are equivalent or better than that could be achieved by either system alone." Full text available at http://ec.europa.eu/dgs/energy_transport/galileo/documents/official_en.htm.

demands mentioned above. In other words, the major cause of this US-European agreement was a compromise in which the US compensated Europe for accepting Galileo as an independent satellite navigation system in exchange for European respect of US security and commercial interests (Lewis 2004a, 8). In sum, transatlantic contradictory political, economic, and security preferences in the field of satellite navigation were reconciled by changes of structural situation, and thereby brought about a modification of strategies in transatlantic disputes over the developments of their navigation satellite systems.

3.2.3. Causal Mechanism of the Case

This case is inconsistent with realism even in the transatlantic competition phase because Europe and the US tried to protect their respective interests in absolute terms. Their individual buildup of navigation satellite system aimed not at balancing each other, but increasing respective security against external threats. The transatlantic competition phase is somewhat consistent with the prediction of hegemonic stability theory. Europe possessed similar technological capability to the US one in the field of satellite navigation, and the US was unable to provide beneficial navigation data to Europe. However, hegemonic stability theory cannot explain the cooperation turn, since the US was unable to dictate European behavior and prevent PRC's participation in the Galileo program. On balance, this case is very consistent with neoliberal institutionalism, particularly the shift from competition to cooperation. Europe and the US possessed both contradictory and common interests and the game plan shifts when they realize that they have to cooperate in order to achieve their own objectives.

Similar to the ISS program, the issue of this case was not competition. The key factor that led to the variation of cooperation pattern is also whether they calculated their gains in comparison with others. The US calculated the development of European Galileo system as undermining its security strategy; therefore try to dissuade Europe in order to protect its own interests. After deciding to cooperate, the US calculated transferring its technologies or funds to Europe as undermining its technological superiority vis-à-vis its ally; therefore prevent it in the cooperation with Europe. For Europe, it calculated substantial exchange of technologies and funds with the PRC as facilitating the development of its Galileo system and future benefits from selling the PRC its weapons confined only through Galileo control. Therefore, Europe established a strategic partnership with the PRC to satisfy its own interests, which undermined the US strategy of technological containment against the PRC. And once again, domestic structure of the US and Europe, mainly budgetary constraints, need to be considered.

4. Conclusions

The attempt of looking beyond appearances and explaining human practice in a deeper level of understanding differentiates social scientific knowledge from other forms of knowledge. Accordingly, practice is crucial to make theories tenable, and theories are indispensable to guide observations and identify underlying logics of practice. The two in-depth case studies explicate three significant findings. First, economic crisis and budgetary stringency make international cooperation in large-scale space application programs occur not only between allies such as Europe and the US, but also between rivals such as the US and the USSR/Russia, Europe and the USSR/Russia, and Europe and the PRC. Second, whether to conduct substantial exchange of technologies and funds in international space cooperation (i.e., variation of cooperation pattern) is determined by the degree of self-interest satisfaction rather than security relations, shared ideologies, or collective identities. Third, neoliberal institutionalism surprisingly explains not only US-European space interaction, but also US-USSR/Russia and Sino-European space interactions, which are conventionally regarded as the realm of realist explanation. In sum, rational cost-effective calculation of individual interests according to the international and domestic structures determines states' strategies to achieve their respective goals.

Space is transforming the elements of state power on earth, not only because it will become a major spatiality of colonization or control, but also because it is a new and major source of knowledge. In modern society, knowledge and technology is valued highly as crucial elements of state power. The pursuit of knowledge and advanced technologies that facilitate space exploration and exploitation is therefore a political activity in the Space Age. Therefore, space is instinct with international political significance. Space-faring states regard space as a critical source of their military, strategic commercial and geopolitical interests. They also value advanced space technological capability as a symbol of superiority. As a result, states' space policy goals are always to maximize feasible freedom of space activities and to develop full scope of space technological capabilities in order to satisfy strategic self-interests. Dahl (1989, 88) defines interest as the opportunities to achieve maximum freedom, develop full capabilities, and attain satisfaction of all other things actors judge important. This definition is applicable to international space politics.

Space may be physically infinite; however, for its exploitation there are still several quantitative (e.g., resource scarcity), qualitative (e.g., technological capability), and natural (e.g., gravitational field of the Earth and other celestial bodies, electro-magnetic field, solar wind, and lethal radiation) constraints that lead to struggle over resources allocation among space-faring states (Skolnikoff 1993, 161).

As McDougall (1985, 177) argues, “strategy is a form of economy, a function of scarcity: unlimited resources render strategy unnecessary,” states should find out what strategy is cost-effective to gain greater share of limited space resources and to serve their own interests best.

Space is also a security-sensitive policy domain, in which we expect Europe and the US to cooperate mutual-trustfully in terms of their common interests according to the discourse of transatlantic security community, and the US and the USSR/Russia to compete for their potentially contradictory security interests. However, in the absence of a central overarching authority, space-faring states are primarily concerned with sovereignty and prestige when they conduct space activities. Space exploitation still takes on the character that state power and interest considerations remain prominent. As a result, no matter the space interaction occurred between the US and the USSR/Russia, Europe and the US, or Europe and the PRC, their strategies are highly contingent on external structural situation and rational cost-effective calculation of respective domestic and foreign policy interests.

References

- Abbey, George, and Neal Lane. 2005. *United States Space Policy: Challenges and Opportunities*. Cambridge, MA: American Academy of Arts and Science.
- Ashkenazi, Vidal. 2000. “The Challenges Facing Galileo.” *Space Policy* 16(3): 185-188.
- Axelrod, Robert, and Robert O. Keohane. 1985. “Achieving Cooperation Under Anarchy: Strategies and Institutions.” *World Politics* 38(1): 226-254.
- Baldwin, David A. 1993. “Neoliberalism, Neorealism, and World Politics.” In *Neorealism and Neoliberalism: The Contemporary Debate*, ed. David A. Baldwin, 3-25. New York: Columbia University Press.
- Beidleman, Scott W. 2005. “GPS vs Galileo: Balancing for Position in Space.” *Astropolitics* 3(2): 117-161.
- Bennett, Andrew. 2004. “Case Study Methods: Design, Use, and Comparative Advantages.” In *Models, Numbers, and Cases: Methods for Studying International Relations*, eds. Detlef F. Sprinz and Yael Wolinsky-Nahmias, 19-55. Ann Arbor: The University of Michigan Press.
- Blanchard, Walter F. 2003. “Achieving GPS-Galileo Interoperability: The Challenges Ahead.” *Space Policy* 19(2): 95-99.
- Bolton, Iain Ross Ballantyne. 2009. “Neo-realism and the Galileo and GPS Negotiations.” In *Securing Outer Space*, eds. Natalie Bormann and Michael Sheehan, 186-204. London: Routledge.

- Booker, Christopher, and Richard North. 2005. *The Great Deception: Can the European Union Survive?* 2nd ed. London: Continuum.
- Bortzmayer, Hubert. 1984. "Space Station Poses Dilemma for Europe." *Aerospace America*, February.
- Botcheva, Liliana, and Lisa L. Martin. 2001. "Institutional Effects on State Behavior: Convergence and Divergence." *International Studies Quarterly* 45(1): 1-26.
- Braunschvig, David, Richard L. Garwin, and Jeremy C. Marwell. 2003. "Space Diplomacy." *Foreign Affairs* 82(4): 156-164.
- Brooks, Stephen G., and William C. Wohlforth. 2008. *World Out of Balance: International Relations and the Challenge of American Policy*. Princeton: Princeton University Press.
- Butrica, Andrew J. 2008. "The 'Right' Stuff: The Reagan Revolution and the U.S. Space Program." In *Remembering the Space Age*, ed. Steven J. Dick, 121-134. Washington DC: NASA Office of External Relations, History Division.
- Buzan, Barry, Charles Jones, and Richard Little. 1993. *The Logic of Anarchy: Neorealism to Structural Realism*. New York: Columbia University Press.
- Casarini, Nicola. 2006. "The Evolution of the EU-China Relationship: From Constructive Engagement to Strategic Partnership." Occasional Paper No. 64, European Union Institute for Security Studies, Paris.
- Cox, Robert W. 1986. "Social Forces, States and World Orders: Beyond International Relations Theory." In *Neorealism and Its Critics*, ed. Robert O. Keohane, 204-254. New York: Columbia University Press.
- Dahl, Robert A. 1989. *Democracy and Its Critics*. New Haven: Yale University Press.
- Dickson, David. 1984. "NASA Seeks European Space Partners." *Science*, New Series 223(4642): 1273+1276.
- Donnelly, Jack. 2000. *Realism and International Relations*. Cambridge: Cambridge University Press.
- Dougherty, James E., and Robert L. Pfaltzgraff, Jr. 2001. *Contending Theories of International Relations: A Comprehensive Survey*, 5th ed. New York: Addison Wesley Longman.
- European Commission. 1998. "Towards a 'Trans-European' Positioning and Navigation Network." COM(1998)29 final.
- _____. 1999. "Galileo: Involving Europe in a New Generation of Satellite Navigation Services." COM(1999)54 final.
- _____. 2002. "The European Dependence on US GPS and the Galileo Initiative." Brussels: DG Energy and Transport, 8 February.
- European Council. 1999. "Council Resolution on the Involvement of Europe in a New Generation of Satellite Navigation Services—Galileo Definition-Phase."

- 1999/C 221/01. Luxembourg: Official Journal of the European Communities, 3 August.
- _____. 2001. "Council Resolution on Galileo." 2001/C 157/1. Luxembourg: Official Journal of the European Communities, 30 May.
- _____. 2002. "Council Resolution on Setting Up the Galileo Joint Undertaking." 2002/L 138/1. Luxembourg: Official Journal of the European Communities, 28 May.
- European Space Agency. 2003. "Green Article on European Space Policy: Report on the Consultation Process." Noordwijk: ESA Publications Division.
- Evan, William M., and Bret B. Hays. 2006. "Dual-Use Technology in the Context of the Non-Proliferation Regime." *History and Technology* 22(1): 105-113.
- Falcone, M., R. Lucas, T. Burger, and G. W. Hein. 2006. "The European Galileo Programme." In *EGNOS: The European Geostationary Navigation Overlay System—A Cornerstone of Galileo*, eds. Bruce Battrick and Dorothea Danesy, 435-455. Noordwijk: ESA Publication Division.
- Fierke, K. M. 2007. "Constructivism." In *International Relations Theories: Discipline and Diversity*, eds. Tim Dunne, Milja Kurki and Steve Smith, 166-184. Oxford: Oxford University Press.
- Finley, M. I., ed. 1972. *Thucydides: History of the Peloponnesian War*, translated by Rex Warner. London: Penguin.
- George, Alexander L., and Andrew Bennett. 2005. *Case Studies and Theory Development in the Social Sciences*. Cambridge, MA: The MIT Press.
- Gilpin, Robert. 1975. *U.S. Power and the Multinational Corporation: The Political Economy of Foreign Direct Investment*. London: MacMillan.
- _____. 1981. *War and Change in World Politics*. Cambridge: Cambridge University Press.
- _____. 1987. *The Political Economy of International Relations*. Princeton: Princeton University Press.
- _____. 2001. *Global Political Economy: Understanding the International Economic Order*. Princeton: Princeton University Press.
- Glaser, Charles L. 1994/95. "Realists as Optimists: Cooperation as Self-Help." *International Security* 19(3): 50-90.
- _____. 2010. *Rational Theory of International Politics: The Logic of Competition and Cooperation*. Princeton: Princeton University Press.
- Glaser, Charles L., and Chaim Kaufmann. 1998. "What Is the Offense-Defense Balance and Can We Measure It?" *International Security* 22(4): 44-82.
- Grieco, Joseph M. 1988. "Anarchy and the Limits of Cooperation: A Realist Critique of the Newest Liberal Institutionalism." *International Organization* 42(3):

- 485-507.
- _____. 1993. "Understanding the Problem of International Cooperation: The Limits of Neoliberal Institutionalism and the Future of Realist Theory." In *Neorealism and Neoliberalism: The Contemporary Debate*, ed. David A. Baldwin, 301-338. New York: Columbia University Press.
- Grunberg, Isabelle. 1990. "Exploring the 'Myth' of Hegemonic Stability." *International Organization* 44(4): 431-477.
- Guzzini, Stefano. 1998. *Realism in International Relations and International Political Economy: The Continuing Story of a Death Foretold*. London: Routledge.
- Handberg, Roger. 2007. "Dual-Use as Unintended Policy Driver: The American Bubble." In *Societal Impact of Spaceflight*, eds. Steven J. Dick and Roger D. Launius, 353-368. Washington D.C.: NASA Office of External Relations, History Division.
- Harland, David M., and John E. Catchpole. 2002. *Creating the International Space Station*. London: Springer.
- Harvey, Brian. 2003. *Europe's Space Programme: To Ariane and Beyond*. London: Springer.
- Jenkins, Dennis R. 2008. *Space Shuttle: The History of the National Space Transportation System—The First 100 Missions*, 3rd ed. Hinckley, UK: Midland.
- Jervis, Robert. 1999. "Realism, Neoliberalism, and Cooperation: Understanding the Debate." *International Security* 24(1): 42-63.
- Johnson, Stephen B. 2002. "Space Business," In *Space Politics and Policy: An Evolutionary Perspective*, ed. Eligar Sadeh, 241-280. London: Kluwer.
- _____. 2007. "The Political Economy of Spaceflight." In *Societal Impact of Spaceflight*, eds. Steven J. Dick and Roger D. Launius, 141-191. Washington D.C.: NASA Office of External Relations, History Division.
- Johnson-Freese, Joan. 2002. "Congress and Space Policy." In *Space Politics and Policy: An Evolutionary Perspective*, ed. Eligar Sadeh, 79-103. London: Kluwer.
- _____. 2009. *Heavenly Ambitions: America's Quest to Dominate Space*. Philadelphia: University of Pennsylvania Press.
- Johnson-Fresse, Joan, and Andrew S. Erickson. 2006. "The Emerging China-EU Space Partnership: A Geotechnological Balancer." *Space Policy* 22(1): 12-22.
- Jones, Seth G. 2007. *The Rise of European Security Cooperation*. Cambridge: Cambridge University Press.
- Joseph, Jonathan. 2008. "Hegemony and the Structure-Agency Problem in International Relations: A Scientific Realist Contribution." *Review of*

- International Studies* 34(1): 109-128.
- Katzenstein, Peter J., Robert O. Keohane, and Stephen Krasner. 1999. "International Organization and the Study of World Politics." In *Exploration and Contestation in the Study of World Politics*, eds. Peter J. Katzenstein, Robert O. Keohane and Stephen Krasner, 5-45. Cambridge, MA: The MIT Press.
- Kay, W. D. 1994. "Democracy and Super Technologies: The Politics of the Space Shuttle and Space Station Freedom." *Science, Technology & Human Values* 19(2): 131-151.
- Keohane, Robert O. 1980. "The Theory of Hegemony Stability and Changes in International Economic Regimes, 1967-1977." In *Change in the International System*, eds. Ole R. Holsti, Randolph M. Siverson and Alexander L. George, 131-162. Boulder: Westview.
- _____. 1982. "The Demand for International Regimes." *International Organization* 36(2): 325-356.
- _____. 1984. *After Hegemony: Cooperation and Discord in the World Political Economy*. Princeton: Princeton University Press.
- _____. 1986a. "Theory of World Politics: Structural Realism and Beyond." In *Neorealism and Its Critics*, ed. Robert O. Keohane, 158-203. New York: Columbia University Press.
- _____. 1986b. "Reciprocity in International Relations." *International Organization* 40(1): 1-27.
- _____. 1989. *International Institutions and State Power: Essays in International Relations Theory*. Boulder: Westview.
- _____. 1993. "Institutional Theory and the Realist Challenge after the Cold War." In *Neorealism and Neoliberalism: The Contemporary Debate*, ed. David A. Baldwin, 269-300. New York: Columbia University Press.
- Keohane, Robert O., and Lisa L. Martin. 1995. "The Promise of Institutional Theory." *International Security* 20(1): 39-51.
- Kindleberger, Charles P. 1973. *The World in Depression 1929-1939*. London: Allen Lane, Penguin.
- Kohout, Franz. 2003. "Cyclical, Hegemonic, and Pluralistic Theories of International Relations: Some Comparative Reflections on War Causation." *International Political Science Review* 24(1): 51-66.
- Krasner, Stephen D. 1976. "State Power and the Structure of International Trade." *World Politics* 28(3): 317-347.
- _____. 1991. "Global Communication and National Power: Life on the Pareto Frontier." *World Politics* 43(3): 336-366.
- Krige, John, Arturo Russo, and Lorenza Sebesta. 2000. *A History of the European*

- Space Agency, 1958-1987—Volume II: The Story of ESA, 1973 to 1987.* Noordwijk: ESA Publications Division.
- Kupchan, Charles A. 2002. *The End of the American Era: U.S. Foreign Policy and the Geopolitics of the Twenty-first Century.* New York: Vintage Books.
- Labs, Eric J. 1997. "Beyond Victory: Offensive Realism and the Expansion of War Aims." *Security Studies* 6(4): 1-49.
- Lachow, Irving. 1995. "The GPS Dilemma: Balancing Military Risks and Economic Benefits." *International Security* 20(1): 126-148.
- Lake, David A., and Robert Powell. 1999. "International Relations: A Strategic-Choice Approach." In *Strategic Choice and International Relations*, eds. David A. Lake and Robert Powell, 3-38. Princeton: Princeton University Press.
- Lambakis, Steven. 2001. *On the Edge of Earth: The Future of American Space Power.* Lexington: The University Press of Kentucky.
- Lambright, W. Henry. 2005. "Leadership and Large-Scale Technology: The Case of the International Space Station." *Space Policy* 21(3): 195-203.
- Lambright, W. Henry, and Agnes Gereben Schaefer. 2004. "The Political Context of Technology Transfer: NASA and the International Space Station." *Comparative Technology Transfer and Society* 2(1): 1-30.
- Launius, Roger D. 2002. "Historical Dimensions of the Space Age." In *Space Politics and Policy: An Evolutionary Perspective*, ed. Eligar Sadeh, 3-25. London: Kluwer Academic Publishers.
- Lebow, Richard Ned. 2007. "Classical Realism." In *International Relations Theories: Discipline and Diversity*, eds. Tim Dunne, Milja Kurki and Steve Smith, 52-70. Oxford: Oxford University Press.
- Lembke, Johan. 2001. "Galileo: The Politics of Space and Technology Meets the Politics of Security." Paper presented in the Workshop on Global and Regional Economic Security and Integration, The Swedish Institute of International Affairs, Stockholm, 14-15 December.
- Lewis, James Andrew. 2004a. "Galileo and GPS: From Competition to Cooperation." June. Washington D.C.: CSIS.
- _____. 2004b. "China as a Military Space Competitor." January. Washington D.C.: CSIS.
- Liberman, Peter. 1996. "Trading with the Enemy: Security and Relative Economic Gains." *International Security* 21(1): 147-175.
- Lijphart, Arend. 1971. "Comparative Politics and the Comparative Method." *American Political Science Review* 65(2): 682-693.
- Lindström, Gustav, and Giovanni Gasparini. 2003. "The Galileo Satellite System and

- Its Security Implications.” Occasional Paper 44, European Union Institute for Security Studies, Paris, April.
- Liska, George. 1962. *Nations in Alliance: The Limits of Interdependence*. Baltimore: Johns Hopkins University Press.
- Logsdon, John M. 1991. “International Cooperation in the Space Station Program: Assessing the Experience to Date.” *Space Policy* 7(1): 35-45.
- _____. 2005. *Together in Orbit: The Origins of International Participation in the Space Station*. Honolulu, Hawaii: University Press of the Pacific.
- _____. 2007. “Space in the Post-Cold War Environment.” In *Societal Impact of Spaceflight*, eds. Steven J. Dick and Roger D. Launius, 89-102. Washington DC: NASA Office of External Relations, History Division.
- Lungu, Sorin. 2004. “Power, Techno-Economics, and Transatlantic Relations in 1987-1999: The Case of Airbus Industrie and Galileo.” *Comparative Strategy* 23(4-5): 369-389.
- Lynn-Jones, Sean M., and Steven E. Miller. 1995. “Preface.” In *The Perils of Anarchy: Contemporary Realism and International Security*, eds. Michael E. Brown, Sean M. Lynn-Jones and Steven E. Miller, ix-xxi. Cambridge, MA: The MIT Press.
- Madison John J., and Howard E. McCurdy. 1999. “Spending without Results: Lessons from the Space Station Program.” *Space Policy* 15(4): 213-221.
- March, James G., and Johan P. Olsen. 1999. “The Institutional Dynamics of International Political Orders.” In *Exploration and Contestation in the Study of World Politics*, eds. Peter J. Katzenstein, Robert O. Keohane and Stephen D. Krasner, 303-329. Cambridge, MA: The MIT Press.
- Martin, Lisa L. 2007. “Neoliberalism.” In *International Relations Theories: Discipline and Diversity*, eds. Tim Dunne, Milja Kurki and Steve Smith, 109-126. Oxford: Oxford University Press.
- Martin, Lisa L., and Beth A. Simmons. 1998. “Theories and Empirical Studies of International Institutions.” *International Organization* 52(4): 729-757.
- Mastanduno, Michael, David A. Lake, and G. John Ikenberry. 1989. “Toward a Realist Theory of State Action.” *International Studies Quarterly* 33(4): 457-474.
- Mazurelle, Florent, Jan Wouters, and Walter Thiebaut. 2009. “The Evolution of European Space Governance: Policy, Legal and Institutional Implications.” Working Paper No. 25, Leuven Center for Global Governance Studies, Katholieke Universiteit Leuven.
- McCurdy, Howard E. 1990. *The Space Station Decision: Incremental Politics and Technological Choice*. Baltimore: The Johns Hopkins University Press.
- McDougall, Walter A. 1982. “Technocracy and Statecraft in the Space Age: Toward

- the History of Saltation.” *The American Historical Review* 87(4): 1010-1040.
- _____. 1985. ...*The Heavens and the Earth: A Political History of the Space Age*. New York: Basic Books.
- McKoewn, Timothy J. 1983. “Hegemonic Stability Theory and 19th Century Tariff Levels in Europe.” *International Organization* 37(1): 73-91.
- Mearsheimer, John J. 1994/95. “The False Promise of International Institutions.” *International Security* 19(3): 5-49.
- _____. 1995. “A Realist Reply.” *International Security* 20(1): 82-93.
- _____. 2001. *The Tragedy of Great Power Politics*. New York: W. W. Norton.
- Milner, Helen V. 1991. “The Assumption of Anarchy in International Relations Theory: a Critique.” *Review of International Studies* 17(1): 67-85.
- Mitchell, Ronald, and Thomas Bernauer. 1998. “Empirical Research on International Environmental Policy: Designing Qualitative Case Studies,” *Journal of Environment & Development* 7(1): 4-31.
- Morgenthau, Hans J. 1948. *Politics among Nations: The Struggle for Power and Peace*. New York: Alfred A. Knopf.
- _____. 1967. *Politics among Nations: The Struggle for Power and Peace*, 4th ed. New York: Alfred A. Knopf.
- NASA. 1983. “Economic Effects of a Space Station: Preliminary Results.” 16 June. NASA Historical Reference Collection, History Office, NASA Headquarters, Washington D.C.
- _____. 1984. “James M. Beggs, Administrator, NASA, to Kenneth Baker, MP, Minister of State for Industry with Special Responsibility for Space and Information Technology.” 6 April. NASA Historical Reference Collection, History Office, NASA Headquarters, Washington D.C.
- _____. 1992. “Implementing Agreement between the National Aeronautics and Space Administration of the United States of America and Russian Space Agency of the Russian Federation on Human Space Flight Cooperation.” 5 October. NASA Historical Reference Collection, History Office, NASA Headquarters, Washington D.C.
- _____. 1993. “Protocol to the Implementing Agreement between the National Aeronautics and Space Administration of the United States of America and Russian Space Agency of the Russian Federation on Human Space Flight Cooperation of October 5, 1992.” 16 December. NASA Historical Reference Collection, History Office, NASA Headquarters, Washington D.C.
- NASA Advisory Council. 1998. “Report of the Cost Assessment and Validation Task Force on the International Space Station.” NASA Headquarters, Washington D.C., 21 April.

- NASA Aerospace Safety Advisory Panel. 2009. "Annual Report for 2008." NASA Headquarters, Washington D.C., 15 April.
- North, Richard. 2004. "Galileo: The Military and Political Dimensions." Article 47, The Bruges Group, London.
- Olson, Mancur. 1965. *The Logic of Collective Action: Public Goods and the Theory of Groups*. Cambridge, MA: Harvard University Press.
- Pace, Scott. 1996. "The Global Positioning System: Policy Issues for an Information Technology." *Space Policy* 12(4): 265-275.
- Pace, Scott, Gerald P. Frost, Irving Lachow, David R. Frelinger, Donna Fossum, Don Wasseem, and Monica M. Pinto. 1995. *The Global Positioning System: Assessing National Policies*. Santa Monica, CA: RAND.
- Pasco, Xavier, and Laurence Jourdain. 2002. "Comparative Space Policy: The Space Policy Crisis in the American, European, and French Space Programs." In *Space Politics and Policy: An Evolutionary Perspective*, ed. Eligar Sadeh, 317-334. London: Kluwer.
- Pedersen, Kenneth S. 1982. "Strategy for International Cooperation in Space Station Planning." Letter from Director of International Affairs, NASA, to Director of Space Station Task Force. August. NASA Historical Reference Collection, History Office, NASA Headquarters, Washington D.C.
- Perrow, Charles. 1986. *Complex Organizations: A Critical Essay*, 3rd. ed. New York: McGraw-Hill.
- Rose, Gideon. 1998. "Neoclassical Realism and Theories of Foreign Policy." *World Politics* 51(1): 144-172.
- Russo, Arturo. 1999. "Science in Space vs Space Science: The European Utilization of Spacelab." *History and Technology* 16(2): 137-178.
- Sabathier, Vincent, G. Ryan Faith, and Alexandros Petersen. 2008. "Ensuring U.S. Access to the International Space Station." CSIS Commentary, 15 August.
- Sadeh, Eligar. 2002a. "Public Administration of the Space Program." In *Space Politics and Policy: An Evolutionary Perspective*, ed. Eligar Sadeh, 129-148. London: Kluwer.
- _____. 2002b. "International Space Cooperation." In *Space Politics and Policy: An Evolutionary Perspective*, ed. Eligar Sadeh, 281-316. London: Kluwer Academic Publishers.
- _____. 2004. "Technical, Organizational and Political Dynamics of the International Space Station Program." *Space Policy* 20(3): 171-188.
- Sagan, Carl. 1994. *Pale Blue Dot: A Vision of the Human Future in Space*. New York: Ballantine.
- Schweller, Randall. 2006. *Unanswered Threats: Political Constraints on the Balance*

- of Power*. Princeton: Princeton University Press.
- Secara, Teodora, and Jean Bruston. 2009. "Current Barriers and Factors of Success in the Diffusion of Satellite Services in Europe." *Space Policy* 25(4): 209-217.
- Sheehan, Michael. 2007. *The International Politics of Space*. London: Routledge.
- Skolnikoff, Eugene B. 1993. *The Elusive Transformation: Science, Technology, and the Evolution of International Politics*. Princeton: Princeton University Press.
- Smith, Mark J. 1998. *Social Science in Question*. London: Sage.
- Snidal, Duncan. 1985. "The Limits of Hegemonic Stability Theory." *International Organization* 39(4): 579-614.
- Snyder, Don, Patrick Mills, Katherine Comanor, and Charles Robert Roll, Jr. 2007. "Sustaining Air Force Space Systems: A Model for the Global Positioning System." Santa Monica, CA: RAND.
- Space and Security Panel of Experts (SPASEC). 2005. "Report of the Panel of Experts on Space and Security." Brussels: European Commission, 1 March.
- Spencer, John, Brian G. Frizzelle, Philip H. Page, and John B. Vogler. 2003. *Global Positioning System: A Field Guide for the Social Sciences*. Oxford: Blackwell.
- Squassoni, Sharon, and Marcia S. Smith. 2005. "The Iran Nonproliferation Act and the International Space Station: Issues and Options." Congressional Research Service, CRS Report for Congress, 22 August.
- Stein, Arthur A. 1990. *Why Nations Cooperate: Circumstance and Choice in International Relations*. Ithaca: Cornell University Press.
- _____. 1993. "Coordination and Collaboration: Regimes in an Anarchic World." In *Neorealism and Neoliberalism: The Contemporary Debate*, ed. David A. Baldwin, 29-59. New York: Columbia University Press.
- Stuart, Jill. 2009. "Unbundling Sovereignty, Territory and the State in Outer Space: Two Approaches." In *Securing Outer Space*, eds. Natalie Bormann and Michael Sheehan, 8-23. London: Routledge.
- Sturdevant, Rick W. 2007. "NAVSTAR, the Global Positioning System: A Sampling of Its Military, Civil, and Commercial Impact." In *Societal Impact of Spaceflight*, eds. Steven J. Dick and Roger D. Launius, 331-351. Washington D.C.: NASA Office of External Relations, History Division.
- Trachtenberg, Marc. 2005. "The Iraq Crisis and the Future of the Western Alliance." In *The Atlantic Alliance under Stress: US-European Relations after Iraq*, ed. David M. Andrews, 201-231. Cambridge: Cambridge University Press.
- Van Evera, Stephen. 1998. "Offense, Defense, and the Cause of War." *International Security* 22(4): 5-43.
- Van Scherpenberg, Jens. 2008. "Trade Is No Superglue: The Changing Political Economy of Transatlantic Relations." In *The End of the West? Crisis and*

- Change in the Atlantic Order*, eds. Jeffrey Anderson, G. John Ikenberry and Thomas Risse, 127-156. Ithaca: Cornell University Press.
- Walt, Stephen M. 1985. "Alliance Formation and the Balance of World Power." *International Security* 9(4): 3-43.
- _____. 1987. *The Origins of Alliances*. Ithaca: Cornell University Press.
- _____. 1998. "International Relations: One World, Many Theories." *Foreign Policy* 110: 29-46.
- Waltz, Kenneth N. 1979. *Theory of International Politics*. Reading, MA: Addison-Wesley.
- _____. 1990. "Realist Thought and Neorealist Theory." *Journal of International Affairs* 44(1): 21-37.
- _____. 1993. "The Emerging Structure of International Politics." *International Security* 18(2): 44-79.
- _____. 2002. "Structural Realism after the Cold War." In *America Unrivaled: The Future of the Balance of Power*, ed. G. John Ikenberry, 29-67. Ithaca: Cornell University Press.
- Wang, Sheng-Chih. 2009. "The Making of New 'Space': Cases of Transatlantic Astropolitics." *Geopolitics* 14(3): 433-461.
- Whalen, David J. 2007. "For All Mankind: Societal Impact of Application Satellites." In *Societal Impact of Spaceflight*, eds. Steven J. Dick and Roger D. Launius, 289-312. Washington D.C.: NASA Office of External Relations, History Division.
- White House. 1992. "Joint Statement on Cooperation in Space." 17 June. NASA Historical Reference Collection, History Office, NASA Headquarters, Washington D.C.
- _____. 1993. "United States-Russian Joint Commission on Energy and Space—Joint Statement on Cooperation in Space." 2 September. NASA Historical Reference Collection, History Office, NASA Headquarters, Washington D.C.
- Wiener, Jarrod. 1995. "'Hegemonic' Leadership: Naked Emperor or the Worship of False Gods?" *European Journal of International Relations* 1(2): 219-243.
- Wohlforth, William C. 1993. *The Elusive Balance: Power and Perceptions during the Cold War*. Ithaca: Cornell University Press.
- Wolfers, Arnold. 1962. *Discord and Collaboration: Essays on International Politics*. Baltimore: Johns Hopkins University Press.
- Yakovenko, A. 1999. "The Intergovernmental Agreement on the International Space Station." *Space Policy* 15(2): 79-86.