

# **Economic Vulnerability and Nuclear Behavior: Explaining Divergent Outcomes in Iran and North Korea**

Enola Vicic Hajdinjak

Honors Thesis, Drew University,

Department of International Relations & Economics

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Research Question: Why have economic sanctions had divergent effects on the nuclear programs of Iran and North Korea, and what does this reveal about the relationship between economic vulnerability and international security behavior?

Abstract: The thesis argues that sanctions were more effective in shaping Iranian nuclear policy because Iran's globally integrated, oil-dependent economy created structural vulnerabilities that sanctions directly targeted. By contrast, North Korea's largely autarkic economy, while reliant on external aid from key patrons, combined with strong regime insulation, protected the leadership from the kinds of economic shocks that typically generate policy change. The broader theoretical claim is that sanctions work when states are economically vulnerable and embedded in global markets, and they fail when regimes are insulated, repressive, or able to shift economic costs onto their populations.

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## Chapter 1: Introduction

Nuclear weapons are one of the greatest threats to global security. Countries that possess them have the potential to cause massive harm, making the control of nuclear programs a central concern for the international community. One key tool for limiting nuclear development is economic sanctions. Sanctions restrict trade, financial transactions, or access to resources in order to pressure a country to change its policies. In theory, sanctions should make it more difficult for countries to pursue nuclear weapons. In practice, however, their effectiveness varies. For example, Iran has partially complied with international demands, while North Korea has continued its nuclear development despite multiple waves of sanctions. This variation highlights a broader puzzle about the conditions under which sanctions succeed or fail. The question becomes especially urgent in light of recent international efforts in 2025 and 2026, including the United States and Israel taking covert and overt measures to disrupt Iran's nuclear program, which demonstrate that sanctions operate alongside a complex web of political and security pressures.

This study addresses the central question: Why have economic sanctions had divergent effects on the nuclear programs of Iran and North Korea, and what does this reveal about the relationship between economic vulnerability and international security behavior? To answer this question, the research examines several interrelated factors. First, how does a country's economic structure shape the effectiveness of sanctions? Second, how do regime type, governing ideology, and national identity influence a country's response to sanctions? Third, how does the composition of sanctioning actors, whether unilateral or multilateral, affect outcomes? Finally, how do these factors interact to explain the contrasting trajectories of Iran and North Korea? By addressing

these questions, this study provides both empirical and theoretical insight into the limits and potential of sanctions as a tool of international security policy.

This research is important for both global security and international economics, though its implications vary depending on theoretical perspective. Nuclear weapons pose serious risks, but some scholars, particularly realists like Waltz (2012), argue that they can also be stabilized by deterring direct conflict between states. At the same time, economic sanctions are widely used as a tool to influence trade, finance, and political behavior, making it important to understand the conditions under which they succeed or fail. Comparing Iran and North Korea allows us to examine how economic structure, regime characteristics, and national identity shape the effectiveness of sanctions. This analysis is relevant for policymakers, including both Western and non-Western actors, who design strategies to prevent nuclear proliferation, though their goals and approaches may differ.

This thesis focuses specifically on Iran and North Korea. While many studies examine a single country or focus narrowly on military issues, this research combines insights from economics and international relations theory. It engages with existing literature on sanctions, including works by Hufbauer, Oegg, and Marinov (2007), to demonstrate how economic pressure interacts with state behavior. The analysis draws on three theoretical perspectives. Realism emphasizes that states prioritize security and power, suggesting that sanctions may have limited effect if nuclear weapons are seen as essential for deterrence. Liberalism highlights the role of international institutions, cooperation, and rules in shaping state compliance. Constructivism focuses on how a country's identity, culture, and shared norms, both within the country and in its interactions with the international community, influence its choices. Clarifying these concepts helps explain why sanctions succeed in some contexts but fail in others.

The study uses a comparative case study method, to examine Iran and North Korea from the 1990s to the present. It evaluates both formal compliance, such as signing treaties, suspending nuclear tests, and permitting inspections, and informal behavior, including hidden enrichment programs or strategic signaling. The thesis is organized into four chapters: an introduction, theory and hypotheses, literature review, case study analysis, and a conclusion that offers policy recommendations.

By comparing these two countries, this research identifies the conditions under which sanctions are effective and when they are likely to fail. It also situates these findings within ongoing debates in the literature, acknowledging that some scholars, particularly realists like Waltz, argue that nuclear weapons themselves can deter conflict, which complicates assessments of sanctions' impact both on specific state policies and, more broadly, on regional or global security.

Understanding these dynamics contributes to more informed policy decisions and a deeper appreciation of the complex interplay between economic pressure, state identity, and international security.

### **Three Approaches to National Security in International Relations**

Nuclear weapons are widely regarded as one of the most consequential tools for national security. Scholars have analyzed their significance through several theoretical lenses, particularly *realism*, *liberalism*, and *constructivism*. Realist perspectives emphasize that nuclear weapons influence the balance of power and enhance a state's ability to deter external threats, although the precise effects remain debated. For example, Waltz (1979; 2012) argues that nuclear weapons can promote stability through deterrence, while Morgenthau (2006) and Hufbauer, Schott, Elliott, and Oegg (2007) highlight the role of state power and coercion in international politics.

Economic sanctions, in this framework, are understood as instruments of coercion that increase the costs of pursuing nuclear weapons programs. However, scholars such as Pape (1997) and Drezner (1999) question the effectiveness of sanctions, arguing that states can often shift the burden onto domestic populations or evade external pressures. More recent realist analyses, including Yazdani and Nozari's work on Iran, suggest that sanctions succeed when they exploit structural economic vulnerabilities but fail against insulated or resilient regimes. Together, this literature provides a nuanced view of when sanctions might influence state behavior and when nuclear weapons themselves reduce the likelihood of compliance.

This thesis examines Iran and North Korea as comparative cases from the 1990s to the present. By analyzing formal compliance, such as treaty ratification, nuclear test suspensions, and inspections, alongside informal behaviors, such as clandestine enrichment or sanctions evasion, the study situates these cases within the broader literature on sanctions effectiveness (Hufbauer et al., 2007; Walterskirchen, Mangott, & Wend, 2019). The cases also illustrate how structural factors, like economic dependency or strategic partnerships with other states (Holroyd, 2022; Morgan, 2022), interact with domestic political ideas and identity to shape compliance outcomes. While some scholars, particularly realists like Waltz, argue that nuclear weapons themselves can act as a stabilizing force and reduce the likelihood of coercion affecting state behavior, this study does not assume sanctions are automatically decisive. Instead, it investigates the conditions under which sanctions are likely to succeed or fail, connecting the structural and domestic factors in Iran and North Korea to broader debates on power, coercion, and state behavior under economic pressure.

Liberal theories highlight the role of institutions, cooperation, and shared norms in shaping state behavior, including nuclear programs. Some studies examine sanctions broadly: Drezner (2003)

argues that multilateral sanctions are generally more effective than unilateral ones because collective action signals legitimacy and reduces opportunities for evasion. Simmons (1998) and Raustiala & Slaughter (2002) emphasize that international institutions coordinate sanctions, monitor compliance, and create reputational costs for non-compliance. Other studies focus specifically on nuclear issues: Silaeva (2021) finds that multilateral sanctions targeting nuclear programs are significantly more effective than unilateral measures, particularly when backed by UN authority, but notes limits where enforcement is weak. From a liberal perspective, sanctions are most likely to succeed when embedded in institutional frameworks such as the Non-Proliferation Treaty (NPT) and enforced collectively, because this strengthens legitimacy, coordination, and oversight in nuclear compliance.

Constructivist scholars stress that sanctions affect states not only materially but also symbolically, through norms, legitimacy, and identity. Wendt (1999) and Finnemore (1996) argue that state behavior is shaped by shared understandings of appropriate conduct in the international community. From this perspective, sanctions can stigmatize states as norm violators, reinforcing global non-proliferation norms. TuangNah (2020) shows that in North Korea, sanctions failed partly because the regime interpreted them as attacks on its sovereignty and identity, using resistance as a source of domestic legitimacy. Checkel (1997) and Finnemore & Sikkink (1998) also highlight how norm internalization matters: some states comply with signals from the international community, even when material incentives are weak. Constructivism therefore predicts that the effectiveness of sanctions depends on how they interact with the target state's self-identity and legitimacy concerns. In this study, these insights inform the hypotheses that Iran's and North Korea's responses will vary not only according to economic and political

conditions, but also according to how sanctions challenge or reinforce their national identity and perceived legitimacy.

An important nuance in liberal or institutionalist accounts is the distinction between rules (institutions, treaties) and norms (shared expectations and legitimacy). Some liberals or institutionalists emphasize the binding force of rules and enforcement, such as treaty regimes, monitoring, or dispute settlement (Simmons 2000; Mitchell 2002), whereas constructivists emphasize how deeply internalized norms shape behavior even absent coercive enforcement (Finnemore 1996; Wendt 1992). This distinction matters: states may follow treaty rules because they believe in the legitimacy of international institutions, not purely due to penalty threats. Incorporating this rule versus norm distinction helps bridge liberal and constructivist explanations and adds nuance to hypotheses about when sanctions operate as more than simple coercion.

Taken together, these three theoretical traditions offer competing explanations for how sanctions influence nuclear behavior: realists emphasize material coercion and economic leverage, liberals highlight the role of international institutions, economic interdependence, and rules-based frameworks in shaping state behavior, and constructivists focus on norms, identity, and legitimacy perceptions. Rather than assuming they are equally significant, this study compares their explanatory power through empirical cases. The research design operationalizes this comparison by examining Iran and North Korea across material vulnerability, institutional embedding, and identity-related responses to sanctions, testing whether sanctions' effectiveness depends primarily on economic pressures, institutional frameworks, or norms and identity-based concerns.

## **Understanding the Effectiveness of Sanctions**

In the sanctions literature, a central debate revolves around how we conceptualize compliance and success. Some scholars define compliance narrowly as observable adherence to treaty provisions or reductions in prohibited activity, while others broaden the concept to include signaling, where states use limited actions to communicate intentions or willingness to negotiate, and reputational effects, which involve the impact of sanctions on a state's international standing or perceived legitimacy (Simmons 1998; Baldwin 1999). Baldwin argues that we must distinguish between whether sanctions “work,” meaning they induce action, and whether they should be used, since policy choices involve comparing sanctions to alternative tools such as diplomacy or force.

In the nuclear domain, the broad conceptualizations of sanctions success discussed above can be operationalized along multiple, concrete dimensions. These include halting uranium enrichment, limiting plutonium reprocessing, permitting inspections, suspending missile or weapons tests, complying with treaty obligations, or reducing reliance on external technology or weapons transfers. Meanwhile, sanctions intensity refers to how comprehensive and coercive the measures are, such as trade embargoes, financial blacklists, or secondary sanctions, while regime resilience captures institutional capacity, external patron support, and ideological cohesion that buffer states against external pressure. By linking the general debate over compliance and effectiveness to these measurable indicators, these concepts provide a framework for evaluating how and when sanctions meaningfully constrain nuclear development.

This study develops four hypotheses about the effectiveness of sanctions in influencing nuclear behavior. Before presenting them, it is important to clarify the key concepts. Realism is a theory

in international relations that emphasizes power, survival, and self-interest. Realists argue that states pursue nuclear weapons to protect themselves in an anarchic world where security is uncertain. From a liberal perspective, however, nuclear behavior is not determined by security concerns alone: economic interdependence, international institutions, and domestic political pressures can shape state choices. Liberals argue that sanctions can be effective when they are embedded in multilateral frameworks and target states that depend on global markets, because economic costs are transmitted through domestic actors and institutions, creating incentives for policy change. Constructivism highlights the role of ideas, identity, and norms, arguing that states act not only to maximize security or follow rules but also to maintain legitimacy and a favorable social standing in the international community. Security dilemmas occur when a state's actions to increase its security, such as developing nuclear weapons, provoke fear or countermeasures from other states. While realists see these dynamics as driven by material threats, constructivists emphasize that perceptions of threat and appropriate behavior are also shaped by identity, norms, and social expectations.

Another key concept is "sanctions success", which can be defined as achieving the intended change in a state's behavior. For nuclear sanctions, success might involve slowing, or stopping a nuclear weapons program, compelling a state to negotiate, or leading to disarmament. Success can also include creating leverage for future diplomacy, altering a state's perception of costs, encouraging adherence to international norms, or temporarily halting specific activities. Not all sanctions need to fully eliminate a program to be considered successful; even partial progress, such as halting certain nuclear tests, limiting uranium enrichment, or delaying the development of delivery systems, can be meaningful outcomes. These measures can also apply to "treaty compliance", where states may meet some provisions but delay or partially implement others.

Compliance refers to a state's actual actions in response to sanctions, agreements, or treaties. Compliance can take many forms, such as signing treaties, permitting inspections, reducing nuclear activity, halting missile tests, or postponing deployment of delivery systems. It is different from intentions or public statements: a country might declare support for an agreement but continue prohibited activities secretly. Therefore, measuring compliance requires looking at tangible changes in behavior rather than verbal commitments alone, and can include both immediate actions and delays in implementation.

Building on the sanctions literature and the broader theoretical frameworks of realism, liberalism, and constructivism, this study develops four hypotheses to explain variation in compliance with nuclear sanctions. These hypotheses operationalize the different theoretical perspectives in a way that can be tested empirically in Iran and North Korea.

The *economic vulnerability hypothesis* draws primarily on liberal approaches, while also incorporating realist insights, and conceptualizes sanctions as instruments of coercive statecraft that alter the cost-benefit calculations of states (Hufbauer et al., 2007; Drezner, 1999). From a liberal perspective, sanctions are most effective when they operate through economic interdependence, international institutions, and domestic transmission mechanisms. States that are integrated into global trade and financial systems are more exposed to external economic disruption, as sanctions can restrict access to markets, capital, and critical resources. At the same time, realist logic helps explain how states respond to these pressures: when economic constraints threaten state capacity, political stability, or regime survival, leaders may adjust their policies to reduce costs. Sanctions are therefore expected to be most effective when they exploit structural economic dependencies, such as reliance on global trade, foreign investment, or access to international financial systems. In this view, a state like Iran, whose economy is deeply

integrated into global oil markets and financial networks, becomes more vulnerable to external pressure because sanctions directly increase the economic and political costs of pursuing nuclear development. Compliance, therefore, reflects a recalculation of material interests shaped by both external economic pressure and the internal transmission of these costs.

The *regime resilience hypothesis* is grounded primarily in constructivist insights, while also incorporating elements of realist attention to state capacity. Constructivist theory emphasizes that state behavior is shaped not only by material pressures but also by identity, legitimacy, and internalized norms (Wendt, 1999; Finnemore, 1996). Scholars such as Rowley and Weldes further argue that foreign policy responses are shaped through narratives of identity, threat, and national belonging, which influence how states interpret external pressure (Rowley & Weldes, 2012). From this perspective, sanctions may fail when regimes reinterpret external pressure as a threat to national identity or sovereignty, thereby reinforcing domestic legitimacy rather than undermining it. In highly centralized and ideologically cohesive systems, such as North Korea, the regime can frame sanctions as hostile acts imposed by foreign adversaries, strengthening internal solidarity and justifying continued resistance. At the same time, material buffers such as informal markets, repression, and external support from patron states further insulate the regime from economic shocks. As a result, sanctions are less likely to induce compliance when they interact with strong regime identity and institutional resilience.

The *domestic politics hypothesis* reflects liberal theories of international relations, which emphasize the role of internal actors, institutions, and political competition in shaping state behavior (Drezner, 1999; Jo & Gartzke, 2007). Liberalism assumes that states are not unitary actors, but are instead composed of competing interests, factions, and decision-making processes that mediate external pressures. From this perspective, sanctions influence not only the state as a

whole but also the internal balance of power between political groups, such as reformists and hardliners. In contexts where domestic actors bear the economic costs of sanctions and have channels to influence policy, governments may be more likely to compromise or negotiate. Conversely, where political systems limit accountability or concentrate power, leaders may resist external pressure despite economic hardship. This hypothesis therefore predicts that variation in domestic political structures and elite competition will shape whether sanctions translate into policy change.

Finally, the *security dilemma hypothesis* is rooted in realist theory, particularly its emphasis on survival, uncertainty, and the primacy of security in an anarchic international system (Morgenthau, 2006; Waltz, 2012), while also acknowledging constructivist nuance regarding threat perception. Realists argue that when states face acute external threats, they prioritize security and deterrence over economic welfare. In such contexts, nuclear weapons are viewed as essential guarantees of regime survival, making compliance with sanctions unlikely regardless of their economic severity. Sanctions may even reinforce threat perceptions, intensifying the security dilemma by signaling hostility and increasing the perceived need for deterrence. Constructivist insights further suggest that these threats are not purely objective but are interpreted through historical experience and identity. This hypothesis therefore predicts that sanctions will be least effective when nuclear programs are closely tied to existential security concerns, as is the case for states that perceive themselves as vulnerable to external intervention.

Together, these hypotheses allow for a direct comparison of realist (material coercion and security), liberal (economic interdependence, domestic transmission, and institutional mediation), and constructivist (identity and legitimacy) explanations, which will be evaluated empirically in the cases of Iran and North Korea.

Before turning to case studies, it is useful to situate this study within the broader sanctions debate and its methodological challenges. David Baldwin's *The Sanctions Debate and the Logic of Choice* (1999/2000) remains foundational: Baldwin argues that scholars often state the wrong question by conflating whether sanctions work with whether they should be used and, he urges attention to alternative policy tools and costs (e.g., military force, diplomacy). Methodological problems such as selection bias, strategic interaction and counterfactual logic plague cross-case comparisons of sanctions (Hufbauer et al., Pape critiques). For a robust comparison across sanction regimes (e.g., Iran vs. North Korea), this study must explicitly account for these challenges by clarifying how "success" is operationalized, controlling for third-party assistance and addressing endogeneity (i.e, sanctions are often applied where success is expected).

### **A Controlled Comparative Approach on Iran and North Korea**

Empirical research on nuclear sanctions often hinges on whether sanctions are treated as coercive tools, institutional mechanisms, or normative pressures, and how a given state's structure mediates those pressures. For instance, Hufbauer, Schott, and Elliott (2007) maintain a realist orientation: sanctions operate through economic pain and cost imposition as levers of statecraft, directly informing the economic vulnerability hypothesis. Baldwin (1999/2000) complicates this by highlighting that policymakers weigh sanctions relative to diplomacy or force, emphasizing the security dilemma hypothesis, which captures how states prioritize survival over economic costs. On the liberal side, Drezner (2003) and institutionalist scholars argue that multilateral sanctions carry greater legitimacy, monitoring capacity, and enforcement potential. These institutional features strengthen compliance not only at the state level, but also by reshaping domestic political incentives, as firms, bureaucracies, and economic actors within the target state face more coordinated and unavoidable external pressure. This supports the domestic politics

hypothesis, which emphasizes how international economic pressure is transmitted through internal actors and becomes politically salient in policymaking. Compliance literature more generally (Simmons 1998; “Compliance in International Relations”) emphasizes treaty mechanisms, reputational costs, and enforcement institutions, which also feed into liberal-inspired hypotheses about domestic and international pressures. Constructivist scholars push further to ask when norms, identity, and legitimacy override material costs. Wendt (1999), Finnemore, and more recent work such as TuangNah (2020) show that states may resist or reinterpret sanctions when they see them as threats to sovereignty or regime legitimacy, providing theoretical grounding for the regime resilience hypothesis, which examines how identity and external support shape a state’s response. Together, these studies justify a single, explicit set of four hypotheses: economic vulnerability, regime resilience, domestic politics, and security dilemma, that this thesis tests through the comparative case studies of Iran and North Korea.

Iran is an example of a country whose economy is heavily connected to global trade and finance, particularly through oil exports. Economic sanctions targeting oil, banking, and financial transactions have created significant pressures, which scholars suggest contributed to the 2015 Joint Comprehensive Plan of Action (JCPOA) (Nephew, 2017). In the JCPOA, Iran agreed to limit uranium enrichment, reduce nuclear material, and allow inspections by the International Atomic Energy Agency (IAEA). These measures provide an opportunity to examine both formal compliance, such as signing international agreements, and behavioral compliance, including observable changes in nuclear activity. Gürzel (2018) notes that internal political disagreements sometimes slowed or complicated Iran’s response to sanctions, highlighting the potential influence of domestic politics. In analyzing Iran, this study explores how economic vulnerability,

domestic politics, security considerations, institutional frameworks, and identity-based regime resilience interact to shape compliance outcomes, without assuming that sanctions automatically produce change.

North Korea presents a contrasting case. Its economy is largely closed, it relies little on global trade, and it receives political and economic support from countries like China and Russia. Scholars suggest that the regime views nuclear weapons as central to survival and identity (TuangNah, 2020), making it potentially more resilient to sanctions. Reports indicate that North Korea has continued nuclear development despite decades of international pressure (Kristensen & Korda, 2021). From a theoretical perspective, realism highlights the prioritization of security over economic cost (Waltz, 2012), while constructivist accounts emphasize the symbolic and legitimizing role of nuclear weapons for the regime (Wendt, 1999; TuangNah, 2020). This case provides an empirical setting to test hypotheses about regime resilience, the limits of economic pressure, and the role of identity in shaping compliance, rather than assuming outcomes in advance.

Comparing Iran and North Korea shows that sanctions work differently depending on the country's economy and political system. Iran depends on the world economy, so sanctions pressured it to make some compromises. North Korea is isolated and ideologically committed to its nuclear program, so sanctions have limited effect. This supports the economic vulnerability hypothesis, which says sanctions work better on countries that depend on trade and global finance (Nephew, 2017) and the regime resilience hypothesis, which says sanctions are less effective on countries that are self-sufficient, supported by other powers, or strongly ideological (TuangNah, 2020).

Scholars also stress that how sanctions are designed matters. UN sanctions, which are multilateral, are more legitimate and can increase the chance of compliance than sanctions from one country alone, as Drezner (2003) explains. Iran faced both UN and U.S. sanctions, which increased pressure. North Korea faced sanctions too, but often it found ways to bypass them because of weak enforcement and support from China and Russia (Kristensen & Korda, 2021). Success of sanctions can mean different things: it can mean signing an agreement, stopping nuclear or missile tests, allowing inspections, or reducing nuclear activities. True success also includes achieving political goals, like restarting talks or reducing tensions (Nephew, 2017; TuangNah, 2020).

Other factors can explain why sanctions work or fail. Domestic politics, security fears and support from powerful countries all matter. In Iran, disagreements inside the government affected how it responded to sanctions (Gürzel, 2018). In North Korea, fear of the U.S. and South Korea influenced the regime's decision to keep nuclear weapons despite sanctions (Kristensen & Korda, 2021). This shows that to understand sanctions, we need to consider economics, politics and national identity together.

However, while existing research has explored sanctions in Iran and North Korea separately, there is limited systematic comparison of how economic structures, domestic politics, and regime identity interact to shape sanctions' effectiveness. This gap highlights the need for studies that examine both countries under the same theoretical framework, applying consistent measures of compliance, sanctions intensity, and regime resilience.

Building on this gap, the present study compares Iran and North Korea to test how economic vulnerability, domestic political dynamics, and regime identity mediate responses to sanctions.

This study does not assume that sanctions automatically lead to compliance or failure. Instead, it examines how Iran and North Korea differ in their patterns of formal compliance (such as agreements and negotiations) and behavioral compliance (such as changes in nuclear activity), and how these outcomes are shaped by economic exposure, domestic political structures, institutional engagement, and identity-based considerations. By directly contrasting these two cases, this research contributes to the literature by showing not only why sanctions succeed in some contexts and fail in others, but also how these causal mechanisms interact to produce divergent outcomes. These findings inform both theory, by evaluating the explanatory power of realist, liberal, and constructivist perspectives, and policy, by clarifying which conditions make sanctions more or less effective in shaping nuclear behavior.

### **Conclusion: Hypotheses and Methods of the Thesis**

Building on the debates outlined in the literature review, this thesis formalizes four hypotheses to guide the analysis of sanctions in Iran and North Korea. These hypotheses are not assumed facts but explanations that will be examined through the cases. The first, the economic vulnerability hypothesis, posits that sanctions are more likely to induce compliance when the targeted state is deeply integrated into global trade and financial networks. States dependent on international markets and foreign capital, such as Iran, face higher material costs when sanctions disrupt these channels, increasing the likelihood of domestic pressure and policy adjustment. The second, the regime resilience hypothesis, predicts that sanctions are less effective when political institutions allow leaders to absorb or deflect economic hardship. North Korea's centralized control, dense surveillance apparatus, and ideological foundations reduce the extent to which economic shocks threaten elite cohesion, weakening sanctions' coercive leverage. Third, the external patronage hypothesis emphasizes that sanctions lose effectiveness when states receive material and

diplomatic support from powerful external actors. Persistent Chinese trade, energy shipments, and political backing have repeatedly cushioned North Korea from isolation. Finally, the security-driven resistance hypothesis posits that sanctions are least effective when nuclear programs are tightly linked to core regime survival or deterrence strategies. Leaders who view their nuclear capabilities as essential security guarantees may resist external economic pressure, which can reinforce perceptions of vulnerability. These hypotheses provide a structured framework for analyzing how economic structure, political institutions, foreign support networks, and security imperatives mediate sanctions outcomes, and they will be tested in the subsequent case study chapters.

This thesis employs a comparative case study approach using a most-similar systems design to explain why sanctions produced divergent outcomes in Iran and North Korea. The two states share several fundamental characteristics, long-standing adversarial relations with the United States, histories of nuclear development, repeated exposure to multilateral sanctions, and governance by centralized political elites, making them well suited for controlled comparison. The key analytical puzzle lies not in whether sanctions were severe, but in why similar external pressures yielded substantially different responses. Iran's partial compliance, embodied in the 2015 JCPOA, contrasts sharply with North Korea's continued nuclear expansion despite escalating UN sanctions, allowing the analysis to focus on economic structure, regime resilience, external patronage, and security imperatives as potential causal mechanisms. The study draws on multiple data sources, including trade statistics from UN Comtrade, macroeconomic indicators from the World Bank and IMF, nuclear program reports from the IAEA and the Arms Control Association, and sanctions documentation from the United Nations, Office of Foreign Assets Control, and EU regulatory archives. These quantitative indicators are complemented by

qualitative materials such as government statements, diplomatic records, secondary scholarly analyses, and investigative reporting.

Sanctions effectiveness is assessed through observable changes in nuclear behavior, negotiation patterns, and policy adjustments over time. This study examines how economic integration, regime resilience, and external patronage shape these outcomes, using process tracing to explore causal mechanisms rather than simple correlations. Detailed measures and data sources for each factor, as well as case-specific evidence, are presented in the methodology sections accompanying the Iran and North Korea case studies. This approach allows for a structured evaluation of the four hypotheses and a nuanced understanding of why sanctions succeeded in some contexts but not others.

## **Chapter 2: The Case of North Korea:**

### **Autarkic and Isolated but Resilient against Sanctions**

#### **Introduction: Sanctions & Nuclear Persistence**

North Korea presents one of the most challenging cases for understanding the limits of economic sanctions in restraining nuclear weapons programs (Hufbauer et al. 2007; Drezner 2015). Since the early 1990s, the Democratic People's Republic of Korea (DPRK) has repeatedly engaged in cycles of negotiation, partial commitments, withdrawal, and nuclear advancement, revealing a pattern of inconsistent cooperation with international institutions matched by consistent progress in nuclear capability (Horowitz & Narang 2014). To explain why sanctions have failed to generate sustained compliance, it is necessary to situate North Korea's nuclear behavior within its political economy, historical security environment, and evolving relations with external actors, particularly China (Reilly 2014). This chapter analyzes the DPRK from the early 1990s to the present, examining how economic structure, regime resilience (Haggard & Noland 2011), the country's unique ideological framework, and its adaptive evasion strategies (Dudden 2021; Alberts 2022) shaped its nuclear trajectory. The core argument emerging from this case is that sanctions created measurable economic pressure but did not threaten regime survival and often heightened the leadership's perception of insecurity (Sagan 1996), reinforcing rather than weakening the pursuit of nuclear weapons.

In line with the goals of this thesis, this chapter evaluates the escalation of international sanctions on North Korea and the limits of their effectiveness, particularly the gradual weakening of enforcement over time. Guided by the hypotheses outlined in Chapter 1, it assesses how limited economic vulnerability (H1), strong regime resilience and external support (H2), and centralized domestic control (H3) interact to reduce the impact of sanctions, while also considering the

security dilemma framework (H4), which helps explain why nuclear development persists despite external pressure. The chapter also examines China's role as North Korea's primary economic partner and strategic patron, as well as the DPRK's increasingly sophisticated evasion strategies, both of which significantly diluted the intended coercive effects of sanctions.

### **Political Economy & Regime Resilience**

The political economy of North Korea has long insulated the regime from external coercion (Lankov 2013). Although the country experienced limited opening in the 1980s, its economic system remained dominated by state ownership, central planning, and strict political control. Unlike Iran, which depended heavily on global oil markets and international banking systems (Katzman 2015), North Korea entered the sanctions era already possessing minimal integration with global trade (Frank 2005). The collapse of the Soviet Union exacerbated economic decline but also compelled Pyongyang to double down on self-reliance, ideological purity, and internal repression (Armstrong 2013). The Songun ("military-first") policy, formalized under Kim Jong Il, elevated the military as the principal institution of the state and justified allocating scarce resources to defense and strategic weapons (Suh 2007). This structural isolation reduced the leverage of sanctions by limiting the economic channels through which international pressure could be transmitted.

### **Nuclear Program Timeline**

North Korea's nuclear timeline shows a gradual but persistent escalation, with international agreements producing only temporary pauses (Wit et al. 2004; Narang 2017). The DPRK joined

the Nuclear Non-Proliferation Treaty (NPT) in 1985<sup>1</sup>, largely in response to international pressure and early engagement with the United States and neighboring states, signaling a nominal commitment to nonproliferation despite limited domestic enforcement. Compliance with the NPT was slow: inspections agreements were only reached in 1992, and North Korea initially resisted allowing access, later agreeing to limited inspections at seven declared sites (Oberdorfer & Carlin 2014).

In 1994, the Agreed Framework with the United States temporarily froze plutonium production at the Yongbyon reactor in exchange for heavy fuel oil and the promise of light-water reactors. While this framework halted plutonium-based weapons development temporarily, it did not address a potential uranium enrichment path, which offered an alternative and more covert route to weapons development and therefore became a key concern in 2002 when the United States accused North Korea of running a clandestine uranium program. Compliance with the Agreed Framework eventually broke down in the late 1990s due to stalled implementation and mounting suspicions of covert activities (Wit et al. 2004). By 2003, North Korea formally withdrew from the NPT and entered the Six-Party Talks, beginning a decade-long pattern in which diplomatic agreements produced temporary pauses but not sustained disarmament (Pollack 2011).

From 2006 onward, North Korea conducted its first nuclear test, marking an irreversible shift toward weapons status (Narang 2017). Despite repeated aid-for-disarmament packages, joint statements, and principles negotiated in the Six-Party Talks, the regime's commitment routinely collapsed during implementation. Nuclear tests in 2006, 2009, 2013, 2016, and 2017 demonstrated growing technological sophistication (Panda 2020), culminating in the claimed

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<sup>1</sup> North Korea joined the NPT in 1985 following international diplomatic pressure and as part of early engagement with the United States and neighboring states, reflecting a nominal commitment to nonproliferation despite limited domestic enforcement.

hydrogen bomb test in 2017. Each test prompted new UN Security Council resolutions, yet escalating sanctions failed to halt program advancement (Nikitin 2017).

Even during brief periods of rapprochement, such as the partial dismantlement at Punggye-ri in 2018, limited inspections, and historic summits with the United States and South Korea, nuclear activity quickly resumed (Cha & Katz 2018). Satellite imagery in 2019 revealed expansions in missile and enrichment facilities (Panda 2020), and by 2022, North Korea had conducted over seventy ballistic and cruise missile launches in a single year (CSIS 2022). The 2023 constitutional recognition of nuclear weapons signaled the regime's long-term commitment to its arsenal and its rejection of disarmament as a policy objective.

This timeline highlights patterns of partial compliance and strategic signaling: North Korea engaged with international institutions, froze plutonium production temporarily, and allowed limited inspections, but underlying economic insulation, regime resilience, and nuclear identity enabled the regime to continue development through both plutonium and uranium pathways. These patterns set the stage for analyzing the effectiveness of sanctions, the role of external patronage, and the interplay between coercion, legitimacy, and regime priorities.

### **Evolution of International Sanctions**

The sanctions timeline reveals that coercive pressure intensified significantly over time but failed to alter strategic decision-making (Drezner 2011; Hufbauer et al. 2007). Early sanctions in the 1990s were limited and primarily focused on diplomatic condemnation, but the nuclear tests of the mid-2000s triggered comprehensive, multilateral sanctions restricting weapons transfers, luxury goods, and financial transactions (UNSC 2006-2017). The U.S. designation of Banco Delta Asia in 2005 as a primary money laundering concern froze \$25 million of North Korean

assets and temporarily pressured Pyongyang into negotiations, but the effect proved short-lived (Chestnut 2007). Later UNSC resolutions, including those following nuclear tests in 2006, 2009, 2013, 2016, and 2017, expanded sanctions dramatically, targeting coal, iron, fisheries, textiles, and petroleum imports while imposing strict inspections requirements and restricting overseas labor remittances (Nikitin 2017). These measures created real economic strain, contributing to energy shortages, constrained industrial output, and increasing reliance on informal markets (Haggard & Noland 2017). Yet sanctions did not produce the intended political effect, and by 2022, the efficacy of sanctions had weakened further as China and Russia declined to support new UNSC measures, reducing enforcement capacity (Reilly 2022).

Regime resilience is central to understanding why sanctions were unable to compel compliance (Geddes et al. 2018; Weeks 2012). The DPRK possesses one of the world's most repressive political systems, characterized by a dynastic leadership, extensive surveillance, ideological indoctrination, and harsh penalties for dissent (Lankov 2013). The Kim regime has repeatedly demonstrated its ability to redirect the costs of sanctions toward civilians while protecting military and elite interests (Haggard & Noland 2017). Marketization from below, emerging after the 1990s famine, created semi-tolerated informal markets (*jangmadang*) that alleviated some economic pressures but also strengthened the regime by providing new sources of revenue and patronage (Kim & Song 2008). The government adapted by selectively legalizing or co-opting these markets, using them to stabilize the economy while maintaining political control. Internal repression and elite loyalty networks minimized the risk that economic hardship would translate into political instability (Kwon & Chung 2012). As long as sanctions did not threaten regime survival, the leadership had little incentive to trade nuclear weapons, which they viewed as essential, for economic relief (Sagan 1996; Narang 2017).

## **China's Role & External Support**

China's role is equally crucial in explaining the persistence of North Korea's nuclear program despite international pressure (Reilly 2014). For Beijing, North Korea serves as a strategic buffer preventing U.S. influence from reaching its borders (Lee 2019). Although China officially supports denuclearization, it has consistently prioritized regional stability over coercive pressure (Gill 2007). As sanctions tightened, China provided substantial economic lifelines through food aid, fuel supplies, border trade, and reduced enforcement of sanctions (Albert 2020). Even when Beijing supported UNSC resolutions, implementation at the border was uneven, and illicit trade networks flourished (Zhang 2018). After 2020, political coordination among China, Russia, and North Korea deepened, leading Moscow and Beijing to block or dilute further sanctions in the Security Council (Reilly 2022). Chinese and Russian reluctance to enforce restrictions on petroleum deliveries, shipping, and labor exports significantly undermined the coercive force of multilateral sanctions. This external patronage reduced the costs that sanctions were meant to impose and insulated the regime at critical moments when pressure might otherwise have produced negotiation.

## **Evasion & Adaptation Strategies**

Over time, North Korea developed increasingly sophisticated evasion and adaptation strategies to counter sanctions (Alberts 2022). These ranged from traditional smuggling and ship-to-ship transfers of coal and petroleum to digital capabilities such as cyber theft (Park & Glasgow 2021). The growth of illicit financial networks, including the use of foreign front companies and overseas labor remittances, generated substantial revenue streams beyond formal trade channels (Noland 2016). Cyber operations, particularly through the Lazarus Group, a state-linked cyber

unit, enabled the regime to steal billions of dollars from cryptocurrency exchanges, banks, and businesses worldwide, providing a steady flow of hard currency beyond the reach of sanctions (Park & Glasgow 2021). These strategies, combined with counterfeit production, arms sales, and mining exports via covert channels (UN Panel of Experts 2021), demonstrate the regime's ability to innovate and adapt in response to external constraints. Each adaptive measure weakened the impact of sanctions, creating alternative pathways for generating revenue and sustaining the nuclear program.

Patterns of compliance, measured through Tables 1 to 5 (see pages 10–14), visually reinforce the narrative developed in the North Korea case analysis in this chapter. Compliance spikes only occurred in brief moments following diplomatic breakthroughs, such as the Agreed Framework period in the late 1990s, the Six-Party Talks agreements of 2005–2007, and the diplomatic opening of 2018 (Wit et al. 2004; Pollack 2011), but quickly deteriorated once negotiations stalled or security concerns intensified (Narang 2017). These patterns suggest that sanctions alone did not create compliance; rather, compliance emerged when sanctions coincided with diplomatic engagement that was perceived as reliable and enforceable, alongside economic incentives and temporary reductions in perceived security threats (Drezner 2015). As soon as these conditions weakened, nuclear activity resumed. The data reveal a recurring pattern: sanctions generated temporary pauses but not sustained behavioral shifts, and nuclear advancement steadily progressed over the long term.

Taken together, the North Korea case illustrates the limits of sanctions in authoritarian, insulated, and ideologically grounded regimes (Geddes et al. 2018; Weeks 2012). Economic pressure did not translate into political vulnerability; security imperatives outweighed material costs (Sagan 1996); external support from China diluted the effect of multilateral sanctions (Reilly 2014); and

regime adaptation strategies compensated for lost revenue (Alberts 2022). These findings provide strong evidence for the regime resilience hypothesis and the security-driven resistance hypothesis, while challenging the notion that sanctions alone can reverse nuclear programs in states where leadership survival is tightly linked to strategic weapons. The North Korea case therefore establishes a crucial baseline for comparison with Iran, a state that is more economically integrated, internally divided, and engaged with international institutions (Katzman 2015), and where sanctions generated far more substantial, though still contested, compliance.

To situate North Korea's nuclear trajectory, this section first examines the political economy that has historically insulated the regime from external pressure, before turning to the timeline, sanctions evolution, domestic resilience, and evasion strategies. Although this study primarily focuses on the period from the early 1990s onward, the broader historical context from the mid-1980s helps explain the regime's initial interactions with the NPT and early international oversight.

North Korea's nuclear behavior reflects the interaction of multiple forces. Realist logic highlights survival, threat perception, and deterrence, explaining rapid behavioral shifts in response to external pressure or security shocks (Waltz 1979, 2012). Liberal institutionalism sheds light on periods of temporary cooperation, which were possible when monitoring, reciprocal benefits, and credible enforcement aligned, though the intensity of institutional influence varied over time and did not guarantee compliance (Drezner 2003; Simmons 1998). Constructivism, meanwhile, explains the slower-moving, deeply embedded narratives of identity and sovereignty that shaped persistent resistance to transparency and disarmament (Wendt 1999; Finnemore 1996; Tuang Nah 2020). Taken together, these perspectives reveal that North Korea's behavior cannot be explained by a single logic; rather, compliance and defiance emerged from the interaction of

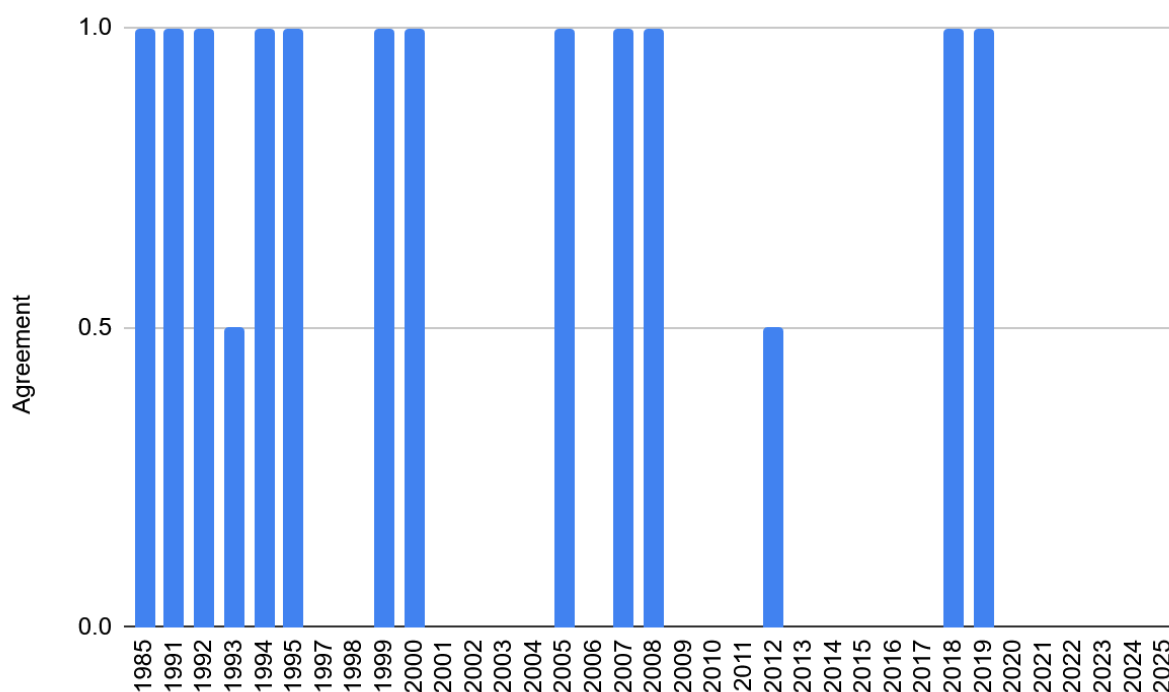
immediate security incentives, variable institutional pressures, and enduring identity commitments (see Table 5).

Between 1985 and 1994, North Korea displayed partial cooperation, reflected in rising compliance values (0.25 → 1.0) in Table 5. These values come from an ordinal compliance scale derived from the event timeline, where 0 represents clear violations (such as nuclear tests or inspection obstruction), 0.5 indicates partial or conditional cooperation (allowing inspections or signing agreements later undermined), and 1 indicates full adherence at that moment. This pattern is also visible in the increase in agreements signed (Table 1) and the brief opening of inspections (Table 4) following NPT accession and the 1992 Joint Declaration.

Under Kim Il Sung's late leadership, engagement was tactical: limited cooperation relieved international pressure without threatening core regime control. Realism explains some of this selective cooperation, agreements like the 1994 Agreed Framework temporarily reduced external threats while leaving strategic capabilities largely intact, but it does not fully account for why North Korea sometimes paused or reversed compliance despite credible security incentives. Liberalism helps explain why cooperation peaked in 1994, as monitoring institutions and tangible reciprocal benefits, such as KEDO (the Korean Peninsula Energy Development Organization) energy assistance, made compliance more attractive (Simmons 1998; Raustiala & Slaughter 2002). Yet liberalism overpredicts the depth of compliance, as North Korea quickly undermined agreements when enforcement was weak or benefits insufficient. Constructivism clarifies why cooperation remained shallow: intrusive inspections threatened core elements of Juche ideology and the regime's legitimacy narrative, limiting the internal acceptance of compliance (Armstrong 2013).

Taken together, these theoretical lenses partially predicted observed behavior but did not perfectly capture all fluctuations in compliance. Realist and liberal logics explain the timing of engagement and the attractiveness of benefits, while constructivist insights explain the limits of compliance and why symbolic or tactical cooperation dominated over transformative change.

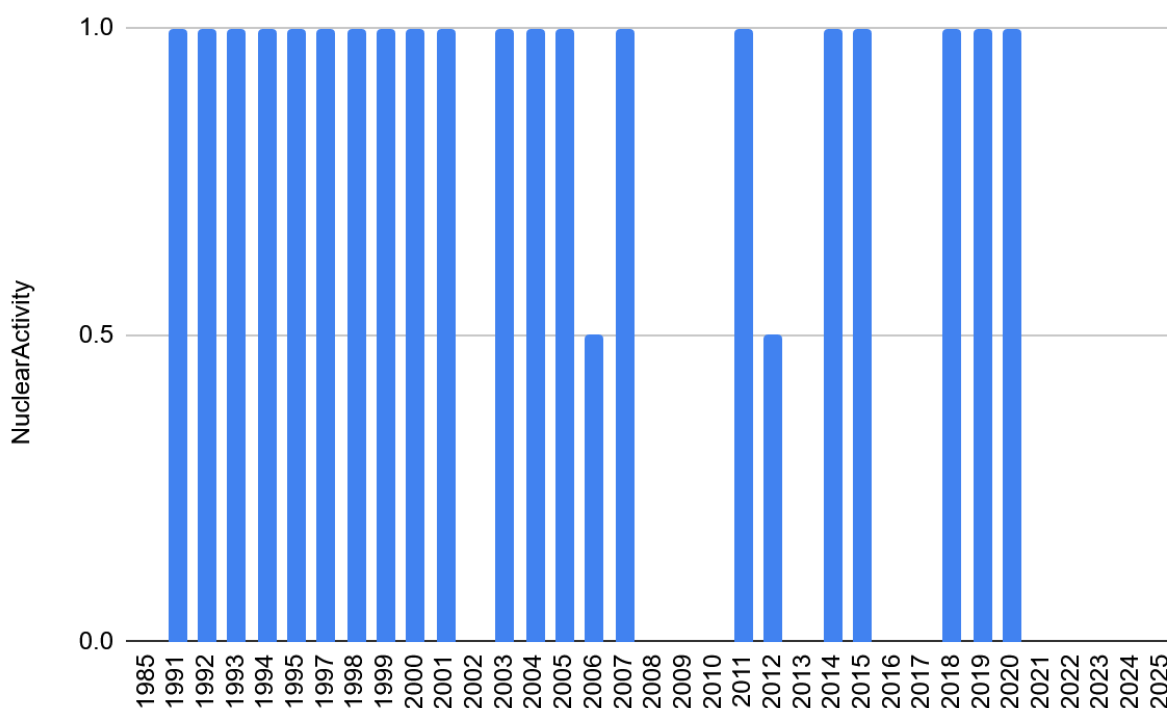
**Table 1: Historical Record of Nuclear and Security Agreements**



From 1995 to 2005, compliance fluctuated at mid-range levels (0.33 → 0.66 in Table 5), as North Korea balanced international engagement with domestic priorities. While the regime participated in agreements intermittently (Table 1), it also continued nuclear development (Table 2), reflecting what the sanctions literature describes as leaders managing **dual pressures**: signaling cooperation to the international community while protecting regime survival and internal legitimacy at home (Pape 1997).

Realism captures key aspects of North Korea's behavior, particularly its continued pursuit of clandestine enrichment after 2002, which reflects a prioritization of regime survival and deterrence over the material costs imposed by UN sanctions (Table 3). However, the timing of escalation also suggests limits to a purely realist explanation, as shifts in nuclear activity often followed changes in diplomatic pressure and enforcement intensity rather than static security conditions alone. Liberalism helps explain periods of temporary cooperation, particularly during the implementation of KEDO (the Korean Peninsula Energy Development Organization) energy assistance and broader institutional engagement, which created short-term incentives for compliance. However, as shown in the data, these cooperative phases were not sustained, as inconsistent enforcement and shifting U.S. policy weakened institutional credibility and reduced compliance over time (Drezner 2003). Constructivism helps explain why compliance remained shallow even during periods of engagement, as the regime's *juche*-based ideology and emphasis on sovereignty limited the internal legitimacy of intrusive verification measures. At the same time, constructivism alone cannot fully explain the timing of rapid escalations or pauses, which appear closely linked to changes in external pressure and negotiation dynamics.

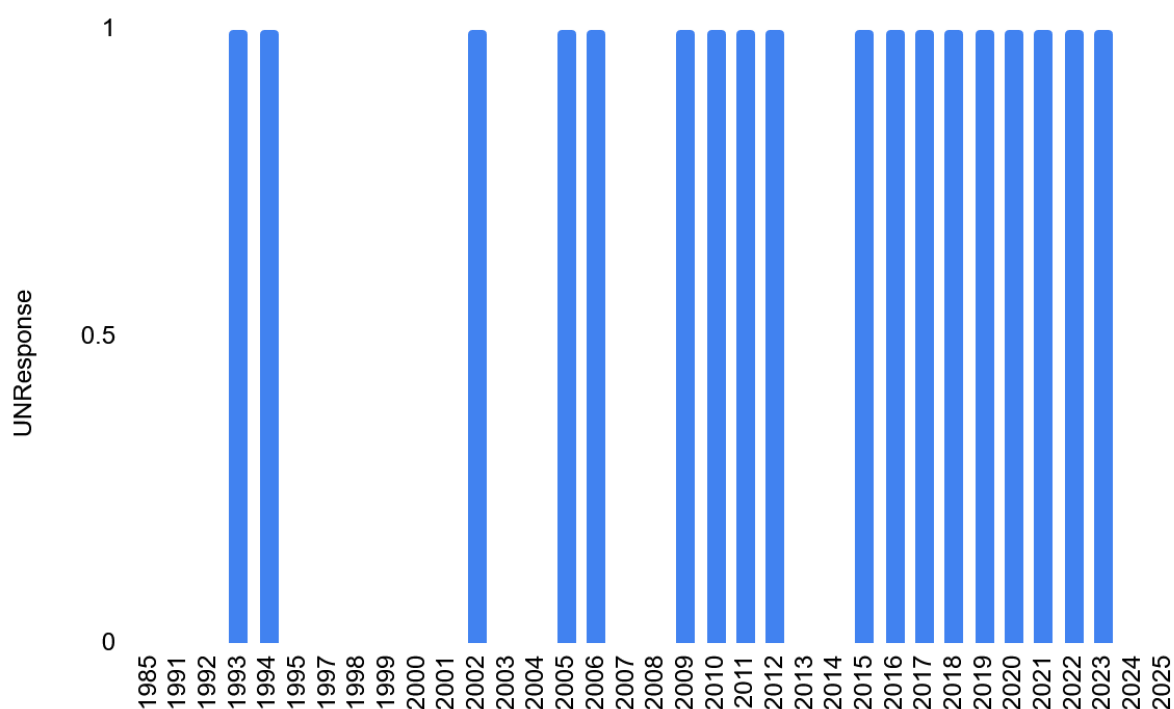
Together, these theoretical lenses show both successes and failures in prediction. Realism accurately anticipates threat-driven escalation, liberalism captures the initial draw of institutional incentives, and constructivism explains persistent limits on compliance. The period demonstrates that no single theory fully explains North Korea's mid-range, unstable compliance; rather, sanctions outcomes result from the interplay of material incentives, institutional credibility, and identity-driven resistance.

**Table 2: Indicators of North Korean Nuclear Program Activity Over Time**

The 2006–2017 period marks the transition from covert development to open nuclearization, with compliance values falling to their lowest levels (0–0.5 in Table 5). Nuclear tests proliferated during this period, reflected in consistently high nuclear activity values (Table 2), while UN responses escalated (Table 3) without substantially altering North Korea’s strategic behavior. Realism provides the clearest explanation: nuclear weapons became the ultimate guarantee of survival, outweighing economic costs (Waltz 2012). Sanctions failed for the reasons Pape (1997) predicted: North Korea could shift economic burdens onto civilians and rely on Chinese tolerance for trade and financial flows. Liberalism helps explain why UN sanctions appear less effective in this case compared to other cases analyzed in this study, as enforcement was uneven, multilateral cohesion inconsistent, and institutional oversight weak (Silaeva 2021).

Constructivism is critical for understanding why nuclear weapons became central to North Korea's identity, propaganda, and regime legitimacy under Kim Jong Un, shaping the regime's interpretation of sanctions and rendering the program non-negotiable as a symbol of sovereignty (Tuang Nah 2020).

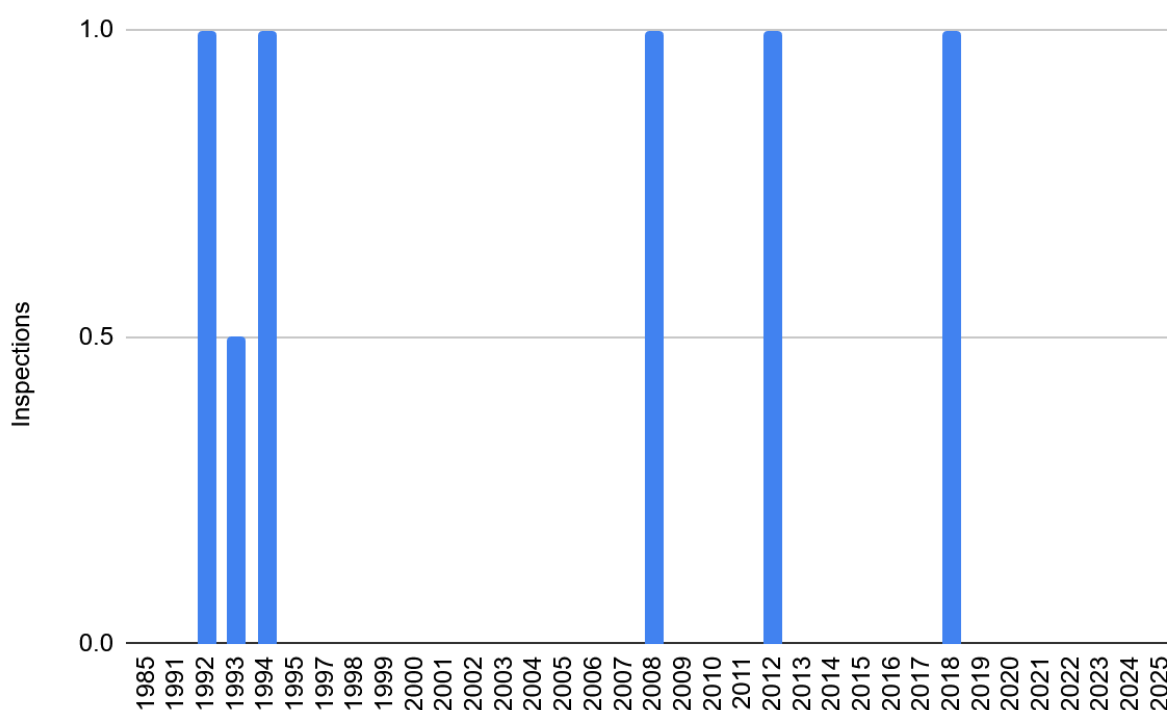
**Table 3: UN Response to North Korea over time**



Between 2018 and 2019, North Korea's compliance briefly increased during a period of heightened diplomacy marked by the Singapore and Panmunjom summits and symbolic actions such as the partial demolition of the Punggye-ri test site. Agreements expanded modestly, and limited inspections resumed (Table 4), reflecting a temporary opening created by summit-level engagement and reciprocal gestures. In this table, a value of 1 indicates the presence of compliance-related behavior (such as agreements, inspections, or reductions in nuclear activity), while 0 indicates its absence. Liberal institutionalism best explains this moment because

multilateral dialogue, confidence-building measures and credible short-term incentives generated conditions for cooperation. However, realism clarifies the rapid breakdown of diplomacy by 2020: sanctions relief did not materialize, verification mechanisms remained unnegotiated and complete denuclearization conflicted directly with regime survival. Constructivism accounts for the aftermath, as the DPRK's 2023 constitutional entrenchment of its nuclear status solidified an identity narrative in which nuclear weapons are framed as permanent and non-negotiable, eliminating incentives for further compliance.

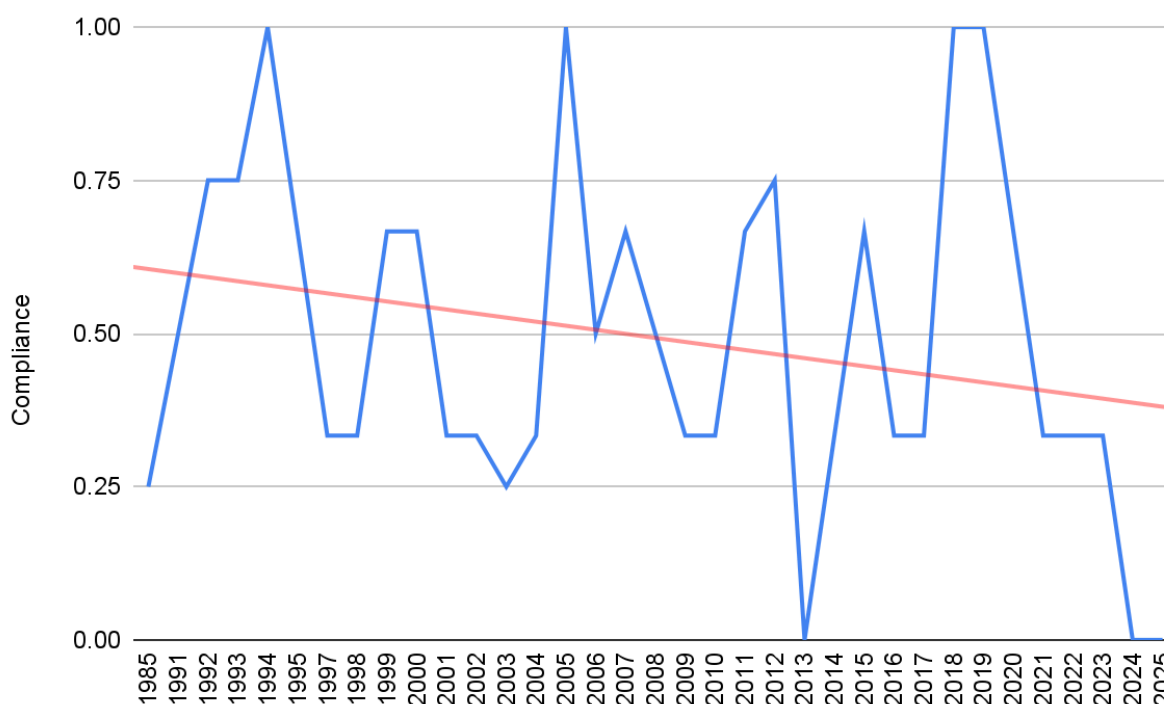
**Table 4: Monitoring and Inspection Access in North Korea's Nuclear Program**



Leadership dynamics reinforce these theoretical patterns. Kim Il Sung permitted conditional cooperation when sovereignty was protected; Kim Jong Il leveraged diplomacy tactically while continuing clandestine efforts; Kim Jong Un briefly pursued recognition and modernization but ultimately institutionalized nuclear identity. This evolution parallels scholarship on authoritarian

resilience, which notes how such regimes reinterpret sanctions as threats or tools for legitimation (Choi 2013; Jo & Gartzke 2007). Across all phases, Table 5 shows that sanctions produced short-lived pauses in compliance but never structural change.

**Table 5: Aggregate of Compliance**



To evaluate changes in North Korea's nuclear behavior over time, this paper uses an aggregate compliance score that synthesizes multiple indicators drawn from the event data: treaty adherence, inspection access, declared nuclear activity, missile behavior and participation in diplomatic agreements. Each component is coded on a 0-1 scale, with 1 representing full compliance (e.g., allowing inspections, freezing facilities) and 0 representing clear violation (e.g., nuclear tests, expelling inspectors). Intermediate values reflect partial cooperation or ambiguity, such as limited inspections, incomplete declarations or mixed signals during negotiations. This aggregate measure is not intended to capture all nuances of North Korea's

behavior; rather, it provides a consistent, comparable approximation across four decades that allows long-term patterns to be visualized and linked to theoretical expectations. Although imperfect, combining multiple behavioral signals into a single index is a common practice in compliance and sanction-effectiveness research because it reduces noise in the data and highlights structural trends rather than isolated events (Hafner-Burton & Montgomery 2006; Kelley 2009). The score therefore functions as a reasonable summary indicator of overall behavior while acknowledging that individual events may diverge from the general pattern.

In addition to year-to-year fluctuations, the linear trendline superimposed on Table 5 highlights the broader trajectory of North Korea's behavior. Rather than remaining stable around a constant average, the fitted line slopes downward over time, indicating a gradual long-term decline in aggregate compliance. This pattern suggests that noncompliance is not merely episodic but increasingly systematic. The decline becomes particularly pronounced during the period of leadership under Kim Jong Un, which is associated with a higher frequency of nuclear and missile tests and fewer sustained diplomatic commitments compared to earlier administrations that intermittently engaged in agreements with South Korea and the international community. The downward trend therefore reinforces the chapter's core argument: sanctions did not generate progressive behavioral change but instead coincided with a deterioration in cooperation, consistent with expectations from the regime resilience and security-dilemma hypotheses.

Overall, the empirical record shows that sanctions failed to generate sustained compliance because they did not alter North Korea's security calculus, institutional incentives or identity-based commitments. Realism explains the persistent prioritization of deterrence; liberalism explains short periods of cooperation under institutional engagement; constructivism explains the regime's deep resistance to transparency and external constraints. Across four

decades, the DPRK cooperated only when engagement aligned with regime benefits and resisted whenever cooperation threatened internal control or ideological narratives. North Korea therefore, illustrates the limits of material coercion in cases of high regime resilience, limited economic integration and strong identity-driven motivations.

### **Quantitative Analysis of Economic Effects**

While the preceding sections demonstrate that sanctions created real economic pressure without altering the DPRK's nuclear trajectory, these conclusions have so far relied primarily on qualitative evidence, historical analysis, and secondary literature. To reinforce these findings with observable data, this section incorporates a quantitative assessment of North Korea's economic performance under sanctions. Because reliable macroeconomic indicators such as GDP, industrial output, or household income are not publicly available for North Korea and official statistics are widely considered inaccurate, scholars increasingly rely on alternative measures for closed economies (Kim 2020; Samimi 2011). Following this approach, the analysis uses energy consumption per capita as a proxy for overall economic activity, which captures fluctuations in industrial output, fuel availability, and resource use. It is important to note that this proxy is imperfect: energy consumption does not perfectly reflect aggregate economic conditions and contains measurement error, meaning the estimated relationship between sanctions and economic activity is likely biased toward zero (attenuation bias), making it more difficult to detect statistically significant effects. This limitation is well-known in econometrics and arises whenever a noisy or partial measure substitutes for the true dependent variable (Wooldridge 2019). Framing the analysis in this way highlights that the modest coefficients observed in subsequent regressions may reflect the proxy's imperfection rather than the absence of real economic pressure, reinforcing the story developed through qualitative evidence.

The goal of this quantitative section is to test whether sanctions had a statistically observable impact on North Korea's economic activity. Because the DPRK does not publish reliable national accounts, this analysis follows the literature in using energy use per capita as a proxy for economic output. Prior research demonstrates that energy consumption closely tracks GDP trends in developing and resource-constrained economies (Lotfalipour et al. 2010; Samimi 2011), and recent work applying this method to North Korea finds consistent correlations between energy demand, industrial activity, and broader economic performance (Kim 2020). Energy use is therefore an appropriate proxy for assessing whether sanctions produced macroeconomic effects strong enough to plausibly influence state behavior.

#### **Data Set and Variables:**

The dataset (Table 6) spans 1990–2023 and includes annual measures of sanctions intensity, nuclear test occurrences, trade levels, and estimated oil imports. The dependent variable is energy use per capita, measured in kilograms of oil equivalent per person, serving as a proxy for overall resource availability and economic output. Per capita measures were chosen to account for potential population changes and because total energy use, gasoline and diesel prices, and related indicators were not consistently reported across the full time period.

International sanctions are the primary independent variable, coded as binary (1 = major international sanctions imposed; 0 = no major sanctions), following widely used approaches in the political economy literature (Haggard & Noland 2011; Reilly 2014). This variable captures the presence of significant external economic pressure rather than precise monetary effects, drawing on UNSC resolutions, U.S. and EU sanctions lists, and secondary literature documenting major sanction episodes. Nuclear test occurrences are included as a binary variable

to reflect years with tests (Panda 2020; CSIS 2022), which may trigger heightened tension or retaliatory international pressure. Trade volume (in thousand USD) and oil imports (in thousand barrels) are included as additional controls to reflect the DPRK's degree of external economic engagement and industrial energy inputs (Haggard & Noland 2011). These variables help isolate the effect of sanctions from fluctuations in trade access and fuel availability.

Because sanctions, trade, and oil imports may be correlated, multivariate regression models are used to isolate the independent relationship between sanctions and energy use. Lagged effects are also incorporated into the analysis, as the economic effects of sanctions and import disruptions may emerge gradually rather than immediately. Diagnostic tests, including the Durbin-Watson and Breusch-Godfrey tests, indicated the presence of serial correlation, justifying the inclusion of a lagged dependent variable in the final specifications.

**Table 6: Variable Description**

<b>Variable</b>	<b>Description</b>	<b>Unit</b>
Energy use per capita	Energy use per capita	kg of oil equivalent per capita
International Sanctions	1 = any major international sanction on DPRK <sup>2</sup>	binary
Nuclear test	1 = nuclear test occurred	binary
Trade	Total foreign trade	thousand USD
Oil import	Crude oil import volume	thousand barrels

<sup>2</sup> The sanctions intensity variable is coded as a binary indicator reflecting the presence of major UN sanctions affecting North Korea in a given year (1 = sanction imposed, 0 = no sanction). Only sanctions that targeted the country as a whole, such as restrictions on trade, finance, or key imports, were included. Sanctions aimed at individual companies or minor measures were excluded to maintain feasibility and because these have limited impact on overall economic activity. While a count of all sanctions could provide additional granularity, the binary measure captures the most salient episodes of international pressure and aligns with prior political economy studies (Haggard & Noland 2011; Reilly 2014).

Table 7 reports descriptive statistics for all variables in the dataset. Energy use per capita displays notable variation ( $SD \approx 268$ ), consistent with the volatility of North Korea's industrial output over time. Sanctions and nuclear tests, coded as binary variables, occur in roughly half of the observed years. Trade and oil imports show wide dispersion, reflecting major shifts in external economic conditions and Chinese support levels. While this variation supports model estimation, it does not preclude the possibility of multicollinearity, especially since sanctions, trade, and oil imports may be highly correlated. To assess this, variance inflation factors (VIFs) or correlation matrices can be examined to ensure that coefficient estimates are reliable and not unduly influenced by overlapping explanatory power. These descriptive patterns provide context for the regression results presented in the next section while highlighting the importance of diagnostic checks for multicollinearity.

**Table 7: Summary Statistics of the Variables**

Variable	Mean	Standard Deviation	Minimum	Maximum
Energy use per capita	809.19	267.72	372.8	1573.6
International Sanctions	0.53	0.51	0	1
Nuclear test	0.64	0.49	0	1
Trade	3,327,033	1,867,326	713,334	7,610,881
Oil import	5240.68	3382.69	2325	18472

**Model:**

Each coefficient reflects a theoretically informed expectation. Stronger sanctions are anticipated to reduce energy availability through constrained imports and reduced economic capacity. The

effect of nuclear tests is ambiguous; tests may provoke sanctions or reflect preexisting strain. Trade is expected to increase energy consumption by enabling greater economic activity, while oil imports are expected to move positively with the dependent variable because the DPRK relies heavily on fuel inputs for industrial and military activity. This specification captures both external pressure and internal economic fundamentals and reflects established approaches in time-series political economy research.

Initial diagnostic tests, including the Durbin-Watson and Breusch-Godfrey tests, indicated the presence of autocorrelation in the baseline model. Autocorrelation can bias standard errors and lead to misleading inferences about statistical significance. To address this, a one-year lag of the dependent variable was added, producing a dynamic specification that better reflects the time-dependent structure of North Korea's economic data. The revised model is expressed as:

$$\text{Energy}_t = \alpha(\text{Energy})_{t-1} + \beta_0 + \beta_1(\text{Sanctions})_t + \beta_2(\text{NuclearTest})_t + \beta_3(\text{TotalTrade})_t + \beta_4(\text{OilImport})_t + u_t$$

The inclusion of the lag is justified both econometrically and substantively. Econometrically, the lag eliminates the autocorrelation detected in the baseline model, as confirmed by improved test (Durbin-Watson and Breusch-Godfrey) results. Substantively, economic disruptions in North Korea do not materialize instantaneously. Constraints on imports, shortages of fuel, and reductions in industrial output unfold gradually, consistent with existing research on sanctions in authoritarian or centrally planned economies (Hufbauer et al. 2007; Kim 2020). A lagged specification therefore offers a more realistic representation of how sanctions-related shocks diffuse through the economy.

The baseline regression indicates that sanctions are associated with a negative effect on energy use, suggesting downward pressure on North Korea's economic activity. However, the magnitude and significance of this effect are modest, consistent with qualitative accounts that sanctions disrupted the economy but did not fundamentally reshape state behavior. The coefficients for nuclear tests, trade, and oil imports display general alignment with theoretical expectations, although significance varies.

### Results:

**Table 8: Regression Results on North Korea's Energy Use per Capita**

Variable (37)	1st Regression	2nd Regression
Energy use per capita		
Energy use per capita lagged		0.57 (0.16)***
International Sanctions	-77.66 (43.26)*	-35.48 (38.95)
Nuclear test	40.51 (41.73)	33.79 (35.84)
Trade	0.00 (0.00)***	0.00 (0.00)
Oil import	0.06 (0.01)***	0.02 (0.01)
Cons	672.03 (50.22)***	305.6 (113.09)**
Note. Standard errors are in parentheses. ***p < .01. **p < .05. *p < .10.		
Autocorrelation Test	1st Regression	2nd Regression
Durbin-Watson	1.44	2.2
Breusch-Godfrey	2.12	0.4

Table 8 presents the coefficients, standard errors, and autocorrelation test statistics from two OLS regressions estimating the determinants of energy use per capita in North Korea: the baseline specification and a model that includes a one-year lag of the dependent variable to correct for autocorrelation. The initial regression suggested some association between sanctions, nuclear tests, and energy use, but the model suffered from strong first-order autocorrelation. This is evident from the Durbin-Watson (DW) statistic of 1.44, which falls well below the threshold of 2 that indicates no autocorrelation, and from the Breusch-Godfrey (BG) test, which was highly significant ( $p = 0.021$ ), indicating the presence of serial correlation in the residuals.

Autocorrelation violates the OLS assumption that errors are independent, which can lead to inefficient estimates and incorrect inference.

To correct for this, a one-year lag of the dependent variable was added. In the corrected specification, the DW statistic increases to approximately 2.21 (close to the ideal value of 2), and the BG test becomes non-significant ( $p \approx 0.41$ ), confirming that autocorrelation was effectively reduced. In this specification, the lagged dependent variable is strongly significant, while the coefficients on sanctions, nuclear testing, trade, and oil imports lose statistical significance. This indicates that most of the variation in energy use is explained by its own past values rather than sanctions or nuclear events, highlighting the high structural persistence of North Korea's energy sector.

Substantively, the magnitude of the coefficients also suggests that sanctions exerted only limited economic effects on North Korea relative to the overall variation in energy use. In the lagged specification, the sanctions coefficient (-35.48) indicates that moving from the absence of major sanctions (0) to the presence of sanctions (1) is associated with an estimated decline of approximately 35 kilograms of oil equivalent per capita in annual energy use. Compared to the

standard deviation of energy consumption (267.72), this represents a relatively modest effect size. Similarly, the coefficient on nuclear testing (33.79) suggests that years in which nuclear tests occurred were associated with an increase of roughly 34 kilograms of oil equivalent per capita relative to non-test years, again small in comparison to the overall dispersion in energy consumption. By contrast, the lagged dependent variable coefficient (0.57) indicates substantial persistence over time, meaning that past energy consumption strongly predicts future energy consumption. Together, these magnitudes reinforce the broader conclusion that structural continuity and regime resilience played a greater role in shaping North Korea's economic trajectory than sanctions or isolated nuclear events alone.

Any concern regarding measurement error is more relevant for the precision of the estimates rather than coefficient bias in this context, particularly given potential limitations in the reliability of energy data in highly closed economies such as North Korea. Since the dependent variable is likely measured with noise, this would tend to increase standard errors rather than systematically attenuate the estimated coefficients, assuming classical measurement error.

Taken together, the regression results provide limited quantitative evidence consistent with the broader argument advanced throughout this chapter. Sanctions appear to have imposed some measurable economic strain on North Korea, but the effects are modest and mostly not statistically significant at conventional levels, meaning that firm inferences about their impact on nuclear behavior are not possible. The lagged model suggests that the DPRK's economy exhibits inertia and gradual adjustment, which may reduce the immediate political relevance of external economic pressure. Although energy use declines slightly in association with sanctions, these disruptions do not provide strong evidence that the regime's strategic incentives regarding its nuclear program were altered. Overall, the quantitative analysis reinforces the qualitative

conclusion only cautiously: sanctions contributed to economic strain, but their effects on regime behavior remain uncertain. These findings set the stage for the concluding section, where the chapter synthesizes qualitative and quantitative evidence to assess the limits of coercive economic pressure on highly resilient states like North Korea.

### **Conclusion: The Limits of Sanctions in Insulated Authoritarian Regimes**

Chapter Two has examined North Korea as a critical case study in understanding why economic sanctions often fail to alter nuclear behavior in highly insulated, authoritarian states. Across four decades, the DPRK experienced cycles of temporary cooperation followed by resumed nuclear advancement, illustrating a pattern in which sanctions generated economic pressure but rarely translated into meaningful policy change. Qualitative analysis shows that regime resilience, centralized control, ideological commitments, and external support, particularly from China, allowed the leadership to absorb economic shocks, redirect costs to civilians, and sustain its strategic nuclear objectives. Adaptive evasion strategies, from smuggling networks to cyber operations, further diluted the intended coercive effects of sanctions, creating alternative revenue streams that maintained the state's industrial and military capacity.

Quantitative analysis complements these findings by demonstrating that sanctions are associated with modest declines in energy use per capita, yet most coefficients are statistically insignificant. Lagged models reveal structural persistence in North Korea's energy consumption, indicating that external pressure diffuses slowly and unevenly, further limiting the immediacy of sanctions' effects. While these results cannot conclusively measure the causal impact of sanctions on nuclear behavior, they align with the broader narrative: economic disruption occurred, but it was insufficient to shift the DPRK's strategic incentives or compromise regime survival.

Integrating theoretical perspectives, realism explains North Korea's consistent pursuit of deterrence and nuclear capability in response to perceived threats, liberal institutionalism accounts for brief windows of cooperation when credible incentives and monitoring mechanisms were present, and constructivism clarifies the enduring influence of identity and sovereignty on long-term non-compliance. The North Korea case therefore illustrates that sanctions are most effective when states are economically vulnerable, globally integrated, and able to be monitored through international institutions when cooperation occurs. Conversely, sanctions are limited in regimes that are economically insulated, ideologically rigid, and supported by external patrons.

This chapter establishes a crucial baseline for comparison with Iran, where differing levels of economic integration, political structure, and institutional engagement produced more substantial, albeit contested, sanction-induced compliance. Together, these findings highlight that the efficacy of coercive economic measures is conditional on structural, political, and normative factors, rather than the mere imposition of international pressure.

### **Chapter 3: The Case of Iran: Resource-Rich and Integrated but Vulnerable to Sanctions**

Iran provides a particularly instructive case for evaluating the economic vulnerability hypothesis because it combines substantial integration into global markets with a political system that is authoritarian but not fully insulated from domestic pressure. Unlike highly autarkic states, Iran relies heavily on oil exports, international banking access, foreign technology, and trade with both Western and non-Western actors. This structural dependence creates measurable points of exposure: sanctions targeting energy exports, financial transactions, and access to hard currency have the potential to generate meaningful economic pressure. The analysis focuses on tracing how these pressures translated into observable adjustments in nuclear policy, domestic elite behavior, and negotiation patterns, rather than simply summarizing prior claims.

Specifically, I examine the years 2006–2015, when multilateral sanctions on oil, finance, and trade intersected with Iran's partial integration into global markets. Sanctions did not need to collapse the entire economy to be effective; they only needed to disrupt channels critical to state revenue and macroeconomic stability. By following export volumes, currency depreciation, inflation, and fiscal stress, this chapter identifies the pathways through which sanctions altered domestic incentives. For example, reduced oil revenue constrained state capacity to maintain subsidies and manage elite patronage networks, creating bargaining leverage for reformist or pragmatic actors (Borszik 2016; Gürzel 2018).

Iran's hybrid political system amplifies these effects. Authority is split between elected institutions (the presidency and parliament) and institutions with limited direct electoral accountability (the Supreme Leader and Guardian Council), alongside semi-autonomous organizations like the IRGC. This institutional fragmentation produces internal competition that

sanctions exploit: economic shocks disproportionately affect factions with ties to import-dependent sectors or exposed constituencies, while hardline actors may leverage the crisis to strengthen narratives of resistance. In this chapter, I examine how these internal dynamics, observable in debates over nuclear negotiations, voting patterns in parliament, and public policy announcements, mediate the impact of sanctions, providing evidence for when and how economic vulnerability translates into policy change.

Economically, Iran's dependence on oil revenue is central to the coercive logic. Sanctions restricting oil exports and energy finance reduced government revenue, limited access to hard currency, and increased inflationary pressures, producing observable effects on both domestic welfare and the state's fiscal flexibility. By tracing these outcomes alongside key nuclear policy decisions, such as delays in enrichment, acceptance of IAEA inspections, and eventual commitments under the 2015 JCPOA (O'Sullivan 2010; Takeyh & Maloney 2011), this chapter shows how structural economic vulnerability aligned with sanctions to shape behavioral change.

Finally, Iran's partial integration into Western-dominated financial networks magnified the effects of sanctions. Restrictions on SWIFT access, correspondent banking, and dollar-denominated transactions created systemic constraints beyond simple trade losses (Katzman 2013). In this chapter, I analyze these chokepoints quantitatively where possible and qualitatively through policy and trade data to demonstrate how targeted economic vulnerabilities translated into nuclear policy adjustments, offering a direct test of the economic vulnerability hypothesis.

In short, this chapter moves beyond prior summaries by linking Iran's structural exposure to measurable policy outcomes, illustrating the mechanisms through which sanctions generated

partial compliance. The analysis sets up a comparison with North Korea, highlighting how differences in economic structure and regime insulation explain the divergent effects of sanctions on nuclear behavior.

Figure 1 illustrates the core macroeconomic mechanism through which sanctions generated pressure on Iran's nuclear program. While Iran's crude oil exports remained relatively stable through much of the 2000s, the early 2010s show a sharp discontinuity as coordinated U.S. and EU restrictions, including financial infrastructure measures targeting payments, insurance, shipping, and banking access, tightened. This pattern aligns with the argument advanced in the sanctions literature that targeting economic chokepoints, rather than applying uniform trade restrictions, can amplify coercive leverage (Hufbauer et al. 2007; Drezner 1999). The partial recovery later in the series demonstrates that export capacity itself did not vanish; rather, it became conditional on political and institutional factors, offering a visible proxy for how sanctions translated into state revenue constraints and bargaining incentives.

Figure 1: Iranian crude oil exports (barrels/day), 2000–2025

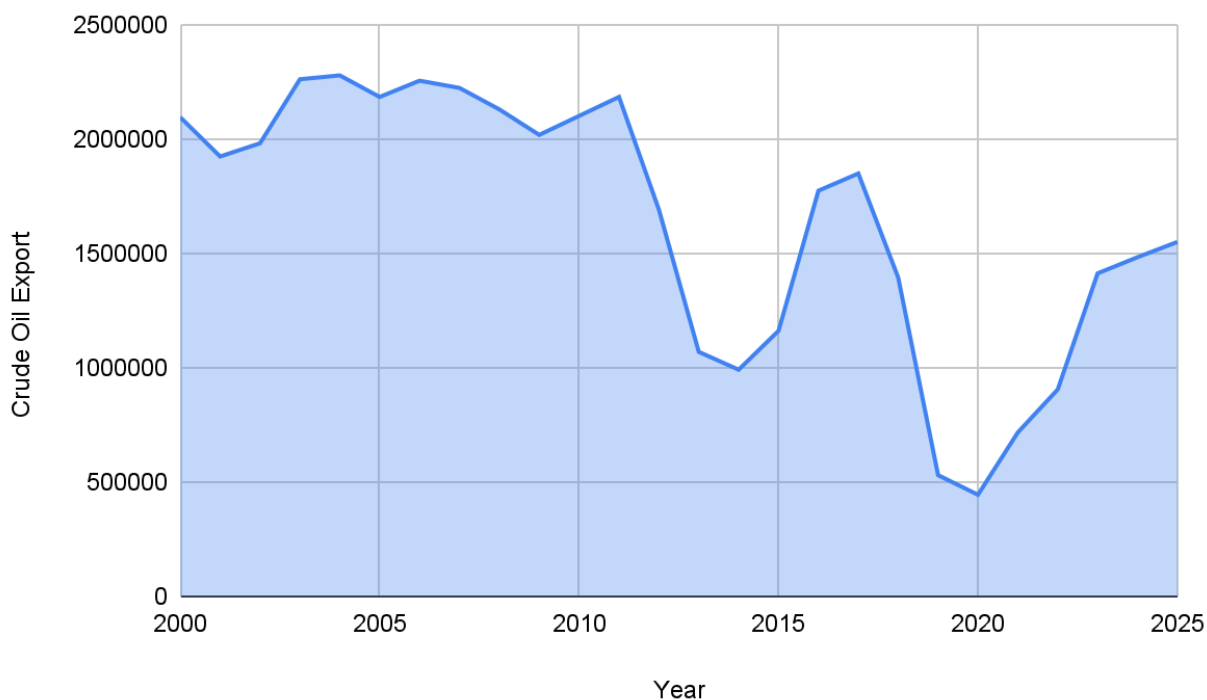


Figure 1 anchors this narrative with quantitative measures of Iranian crude exports during the period of maximum escalation. By focusing on the years with the strongest multilateral coordination, particularly U.S.–EU convergence on financial restrictions including SWIFT exclusion and Central Bank targeting, the table provides concrete evidence of reduced hard-currency access and fiscal stress. Unlike prior studies, which often assess sanctions in broad macroeconomic or political terms (Saikal 2006; Mraz et al. 2016), this analysis directly connects specific sanctions episodes to observable changes in revenue flows, highlighting the pathways through which economic vulnerability translated into partial compliance in nuclear behavior.

In this sense, the figures and tables move beyond descriptive accounts in the existing literature by linking sanctions design to measurable economic outcomes, rather than treating sanctions as a

generic “pressure” variable. They allow for a test of the economic vulnerability hypothesis, showing that Iran’s integration into global markets created structural points of exposure that sanctions could exploit, in contrast with highly autarkic states like North Korea, where similar measures have had limited observable effect (Choi 2013; Moon & Whang 2020). In combining macroeconomic trends with the timing of sanctions, this approach situates the Iran case within the broader theoretical debate on when sanctions succeed or fail (Hufbauer et al. 2007; Drezner 1999) while providing a novel, empirically grounded assessment of the causal mechanisms linking economic structure to nuclear policy adjustments.

### **Timeline of Iran’s Nuclear Program and Sanctions Escalation**

Iran’s nuclear program extends back to the Shah era, but international concern intensified in the early 2000s after revelations about undeclared enrichment facilities at Natanz and Arak. By the late 2000s, Iran had expanded uranium enrichment despite repeated UN Security Council resolutions demanding suspension. While prior accounts often present this history as a chronological narrative (Saikal 2006; Mraz et al. 2016), this study adds a systematic, year-by-year analysis of observable nuclear behavior and its interaction with international actors. I construct a dataset coding each year for nuclear activity, formal agreements or negotiations, inspections, and UN responses, drawing from Arms Control Association reports and IAEA documentation. These yearly indicators go beyond descriptive storytelling by quantifying patterns of escalation, compliance, and engagement, enabling a visual and empirical assessment of how sanctions and diplomacy influenced Iranian nuclear policy. In doing so, this approach highlights shifts between defiance and cooperation, providing a consistent basis for testing the economic vulnerability hypothesis and linking observed behavior to structural and institutional factors, rather than simply recounting past events.

Figure 2: Nuclear Activity over time 1984-2022

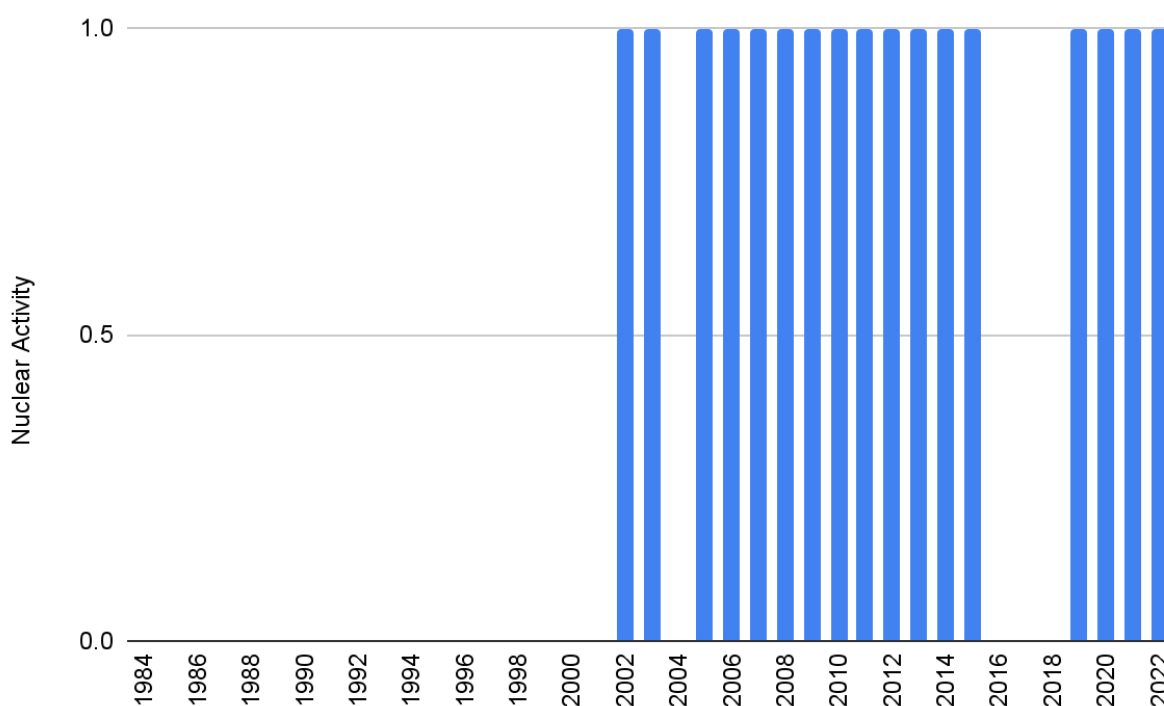


Figure 2 presents my nuclear activity variable, coded as a binary indicator that equals one in years when Iran engaged in observable enrichment or escalation behavior, such as expanding uranium enrichment levels, increasing centrifuge activity, reducing cooperation with inspectors, or taking additional technical steps associated with nuclear weapons capability, and zero in years of suspension or limited activity. Rather than measuring the program as continuously active, this coding captures discrete policy shifts that correspond to changes in Iran's strategic and diplomatic environment. The series shows three clear phases: a long period of inactivity before the early 2000s, sustained activity after the exposure of Natanz and Arak, a temporary decline during the JCPOA compliance years, and renewed escalation after the U.S. withdrawal from the agreement. This stepwise pattern indicates that Iran's nuclear behavior changes in response to

international negotiations and sanctions pressure rather than following a constant upward trajectory. Constructing the variable in this way allows the regression to test whether these politically driven shifts in nuclear activity are associated with changes in economic outcomes.

*Figure 3: Iran's Agreement over time 1984-2022*

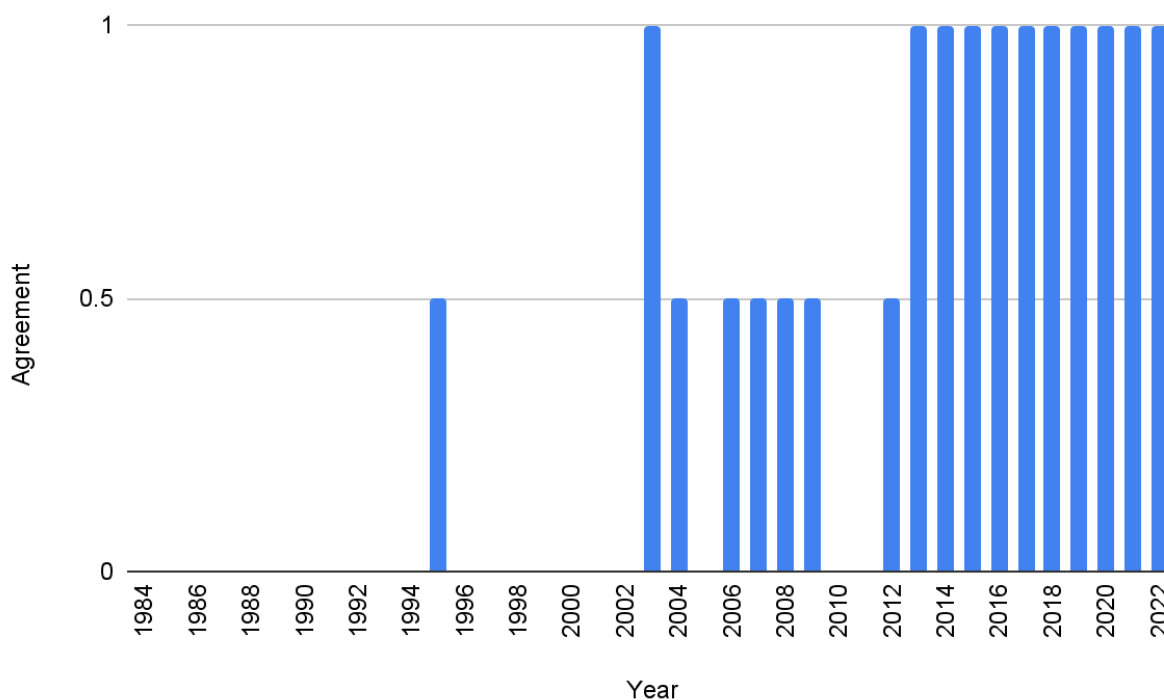


Figure 3 records years in which Iran entered into formal agreements or negotiated commitments, including temporary suspensions of enrichment, confidence-building measures, and ultimately the JCPOA. In the dataset, each year is coded as 1 when Iran entered into a formal agreement or was under an active negotiated commitment, and 0 otherwise. Agreements cluster around periods of heightened sanctions pressure, particularly in the mid-2000s and again after 2013. This timing suggests that diplomatic engagement was not random but systematically correlated with moments of economic strain and multilateral coordination. Rather than rejecting negotiations

outright, Iranian leaders repeatedly returned to bargaining when the costs of isolation increased, consistent with the idea that sanctions created measurable incentives for compromise and partial compliance.

*Figure 4: UN Responses over Time 1984-2022*

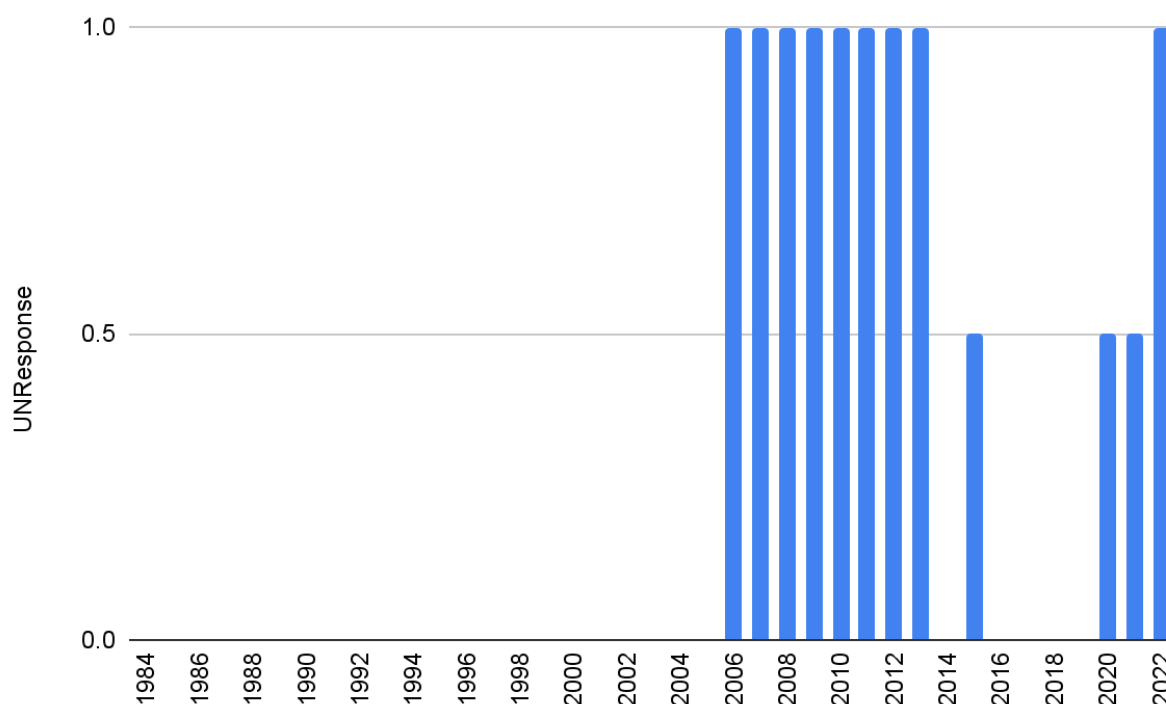
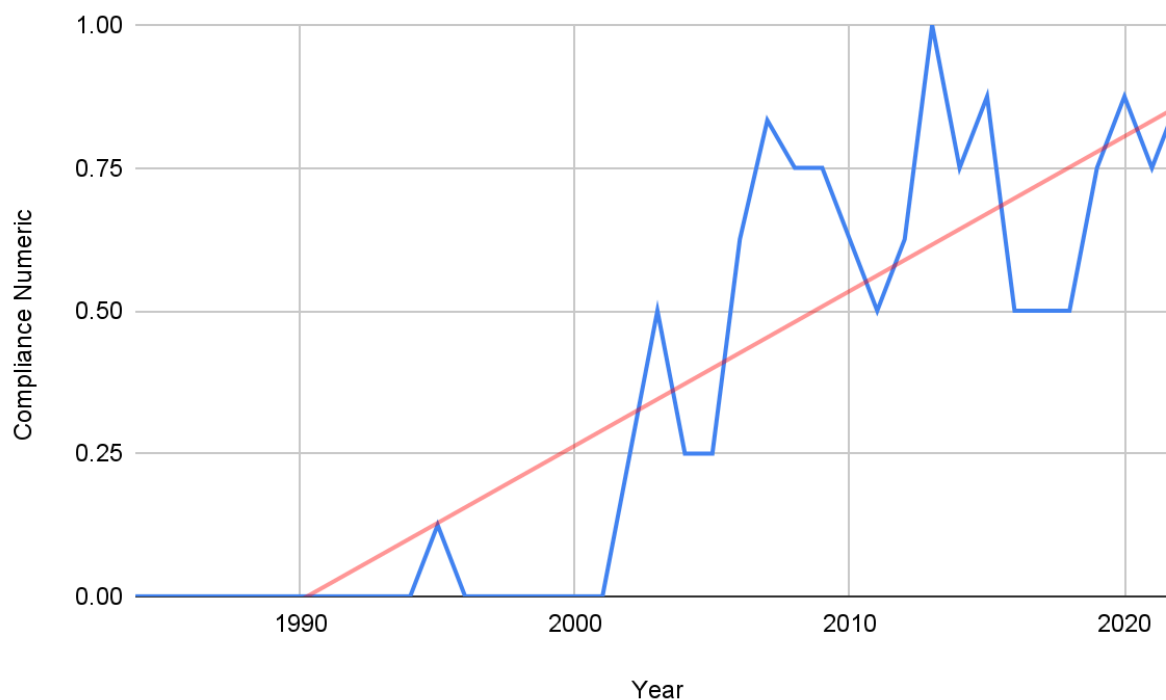


Figure 4 tracks UN responses, including Security Council resolutions and coordinated sanctions measures. In the dataset, each year is coded on a three-point scale: 0 indicates no formal UN action, 0.5 indicates diplomatic pressure or preliminary measures such as statements, warnings, or the initiation of draft resolutions, and 1 indicates the adoption of binding Security Council resolutions or coordinated multilateral sanctions packages. The sharp increase after 2006 reflects the growing multilateralization of pressure on Iran's nuclear program, including both targeted financial measures and sector-specific sanctions. When compared to Figures 3 and 5, peaks in

UN action are followed by rises in formal agreements and verified inspections, suggesting a sequential pattern: international coordination often preceded measurable Iranian concessions.

This pattern provides preliminary support for the economic vulnerability hypothesis, which predicts that sanctions are more effective when they are multilateral and credible, targeting core economic channels. The data show that periods of intensive UN pressure coincide with years in which Iran agreed to suspend enrichment activities, allow inspections, or enter temporary confidence-building measures, consistent with the expectation that sanctions translate into observable behavioral shifts. At the same time, qualitative evidence from secondary sources indicates that compliance was often partial or conditional: some measures, like temporary suspensions, were later reversed, illustrating that sanctions created incentives but did not fully constrain the regime. By integrating both coding of measurable actions and contextual qualitative detail, this analysis links the observed sequence of UN responses, agreements, and inspections directly to the theory-driven expectations outlined in Chapter 1.

Figure 5: Aggregate of all the Variables



Finally, Figure 5 presents a composite compliance index that combines four coded dimensions of Iranian nuclear behavior: formal agreements, inspections, reductions or suspensions of nuclear activity, and engagement with the international community. For each year, the index assigns a value between 0 and 1 for each dimension based on observed events, then averages these values to generate an annual summary score. While simplified, this measure provides a consistent way to track overall behavioral trends over time. To clarify the long-term trajectory beyond year-to-year fluctuations, the figure also includes a linear trendline. Unlike cases where compliance oscillates around a stable average, the fitted line slopes upward, indicating a gradual increase in Iran's overall level of cooperation over time. This positive trend suggests that compliance was not merely episodic or tied to isolated diplomatic moments but became more frequent and sustained, particularly during periods of intensified multilateral sanctions and

negotiations. The upward trajectory is most pronounced after 2010 and culminates in the years surrounding the Joint Comprehensive Plan of Action, when inspections, formal agreements, and temporary nuclear constraints occur simultaneously. In other words, the trendline visually reinforces the chapter's central claim: economic pressure generated cumulative incentives for policy adjustment rather than persistent defiance, consistent with the economic vulnerability hypothesis.

To avoid a purely post hoc interpretation, this analysis is guided by pre-established expectations derived from the economic vulnerability hypothesis. Specifically, the hypothesis predicts that sanctions are more effective when they target core economic channels and are implemented with multilateral coordination, producing observable behavioral responses in the target state. Figure 5 allows these predictions to be evaluated systematically: periods of intensified sanctions and coordinated international pressure correspond with rises in inspections, agreements, and overall compliance, providing preliminary empirical support for the hypothesis. By combining multiple behavioral indicators into a single metric, the index translates the narrative timeline into measurable outcomes, bridging the earlier economic analysis with the institutional and political mechanisms explored later in the chapter.

Between 2010 and 2015, sanctions escalated dramatically in both scope and coordination, creating conditions that ultimately facilitated the negotiation of the Joint Comprehensive Plan of Action (JCPOA). Based on my coding of UN Security Council resolutions and primary reporting on Iranian economic performance, 2010 marks a clear turning point: Resolution 1929 expanded sanctions to cover arms transfers, financial institutions linked to proliferation, and entities associated with the IRGC. This shift moved beyond narrowly targeted measures to broader economic containment, particularly affecting energy and financial channels.

From my analysis, this escalation illustrates a key insight from sanctions theory: effectiveness depends not only on the magnitude of economic damage but on whether measures constrain the target's most valuable revenue streams and transactional networks. In Iran's case, sanctions targeting oil exports, financial transactions, and access to international banking significantly limited the state's ability to buffer domestic costs through reserves or routine trade. By linking my data on export volumes and financial constraints to the timing of these sanctions, I show that the measures increased the political and economic incentives for factions within Iran to pursue negotiated relief, thereby contributing to the eventual JCPOA agreement.

The United States and European Union went further, imposing unilateral and secondary sanctions targeting Iran's Central Bank, energy sector, shipping, and insurance industries. As Katzman (2013) documents, these measures effectively deterred third-country firms from engaging with Iran, even when not legally required to comply. The extraterritorial reach of U.S. sanctions magnified their impact by weaponizing access to the global financial system.

As shown in Figure 1, the sharp contraction in crude exports coincides with the transition from incremental sanctions to coordinated restrictions on oil sales and financial transactions. Using data compiled from the International Energy Agency and UN reports, I track Iranian crude exports, oil revenue, and key financial indicators from 2010 to 2015. My analysis shows that by 2012, sanctions on oil exports and banking reached unprecedented levels, including exclusion from the SWIFT financial messaging system, which severely limited Iran's capacity for international transactions. Crude export volumes fell sharply, government revenues declined, and the Iranian rial depreciated substantially. These changes correspond with rising inflation and widespread shortages of imported goods, including medicines and industrial inputs.

These economic effects had direct political consequences. By linking the macroeconomic indicators to domestic welfare measures, my coding suggests that middle-class and commercial constituencies, particularly those exposed to international trade and finance, experienced meaningful reductions in purchasing power and economic security. This, in turn, created politically salient pressures favoring candidates and factions advocating for pragmatic diplomacy and sanction relief.

These findings are consistent with the literature: Hufbauer et al. (2007) argue that sanctions are most effective when they target critical economic chokepoints, and Ghasseminejad and Jahan-Parvar (2021) provide empirical evidence that financial sanctions affected firm valuations, exchange rates, and access to capital in Iran. What my analysis adds is a direct temporal mapping between the sanctions escalation, observable economic outcomes, and the domestic political environment, showing how structural economic vulnerability translated into concrete bargaining incentives for Iranian policymakers.

Iran attempted various sanction-bypassing strategies, including barter trade, gold transactions (notably with Turkey), and expanded ties with China and other non-Western partners. Using trade data from the IMF and Chinese customs statistics, I analyze the scale and scope of these transactions to assess whether they meaningfully offset the economic impact of Western sanctions. My findings suggest that while such measures mitigated some losses, they did not fully neutralize economic pressure. For example, although China continued to purchase Iranian oil, deliveries were often discounted and subject to restrictive payment arrangements that limited Iran's access to hard currency.

This interpretation is consistent with Scita (2022), who argues that Sino-Iranian trade functioned less as a full substitute for Western markets than as a constrained outlet shaped by China's desire to avoid secondary sanctions. What my analysis adds is a quantitative and temporal mapping showing that, despite these bypass strategies, key indicators of fiscal strain, oil revenue, currency stability, and access to capital, remained under significant pressure during the peak sanction years. This allows me to integrate sanctions evasion into the broader argument: China's trade softened the economic blow but did not eliminate the structural vulnerability that made sanctions effective in shaping Iranian behavior.

The election of President Hassan Rouhani in 2013 marked a turning point. Campaigning on economic recovery and international engagement, Rouhani capitalized on widespread public dissatisfaction with sanctions. His victory reflected how economic vulnerability translated into political change, lending empirical support to the domestic politics hypothesis. He won a clear majority in the first round, signaling broad public support for a shift away from economic isolation and toward negotiation with the international community. Subsequent negotiations with the P5+1 culminated in the 2015 JCPOA, under which Iran agreed to significant constraints on its nuclear program in exchange for sanctions relief.

### **Economic and Financial Effects of Sanctions**

Sanctions targeting Iran's oil sector were particularly consequential. Oil exports declined substantially, depriving the government of revenue needed to sustain subsidies, infrastructure spending, and social programs. The resulting fiscal strain forced difficult trade-offs, exposing the regime to popular dissatisfaction. Unlike regimes that prioritize weapons programs regardless of

civilian welfare, Iran's leadership demonstrated concern about maintaining economic stability to preserve legitimacy, a dynamic emphasized by Takeyh and Maloney (2011).

Financial sanctions amplified these effects. Restrictions on banking access disrupted imports of intermediate goods, technology, and consumer products. Inflation eroded purchasing power, unemployment rose, and economic inequality worsened. Ghasseminejad and Jahan-Parvar (2021) provide systematic evidence that these financial constraints affected not only macroeconomic indicators but also firm-level behavior, reinforcing the argument that sanctions penetrated deeply into Iran's economic structure.

Importantly, sanctions also constrained Iran's nuclear program indirectly by limiting access to specialized materials, components, and expertise. Restrictions on dual-use technology and industrial equipment complicated procurement for centrifuges and related infrastructure. While Iran continued enrichment, sanctions increased costs and slowed progress, demonstrating how economic pressure can intersect with technical constraints.

At the same time, sanctions were accompanied by non-economic coercive measures, including cyber operations (such as Stuxnet), espionage, and Israeli sabotage against nuclear facilities. While analytically distinct from sanctions, these actions formed part of a broader containment strategy. As advised, they are acknowledged here without being treated as primary causal mechanisms; their significance lies in reinforcing pressure rather than replacing economic coercion.

Figure 6: Iranian rial–USD exchange rate, 1950-2010

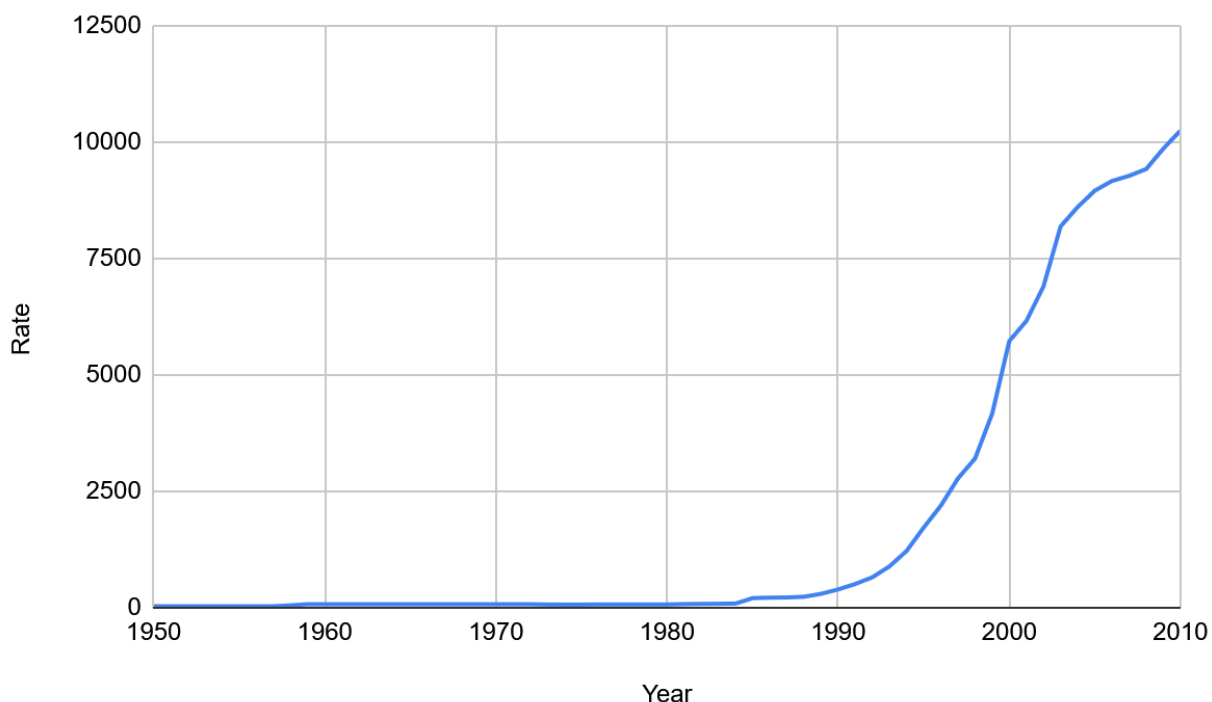


Figure 6 illustrates the sharp depreciation of the Iranian rial against the U.S. dollar during the escalation of sanctions pressure, capturing how external economic coercion translated into immediate domestic instability. The exchange-rate collapse reflects both reduced access to foreign currency, driven by declining oil revenues and restricted financial channels, and rising uncertainty among firms and households about Iran’s economic future. As the rial weakened, import costs surged, inflationary pressures intensified, and everyday consumption became more expensive, reinforcing the broader macroeconomic strain created by sanctions. Importantly, currency depreciation is not only an economic indicator but also a political one: it signals declining state capacity to stabilize markets and protect living standards, increasing the risk of public dissatisfaction and elite contestation. In this sense, the exchange-rate shock demonstrates

how Iran's global economic integration and dependence on external trade and oil income created a direct pathway through which sanctions could generate internal vulnerability and raise the domestic costs of continued nuclear escalation.

*Figure 7: Inflation and GDP growth under sanctions*

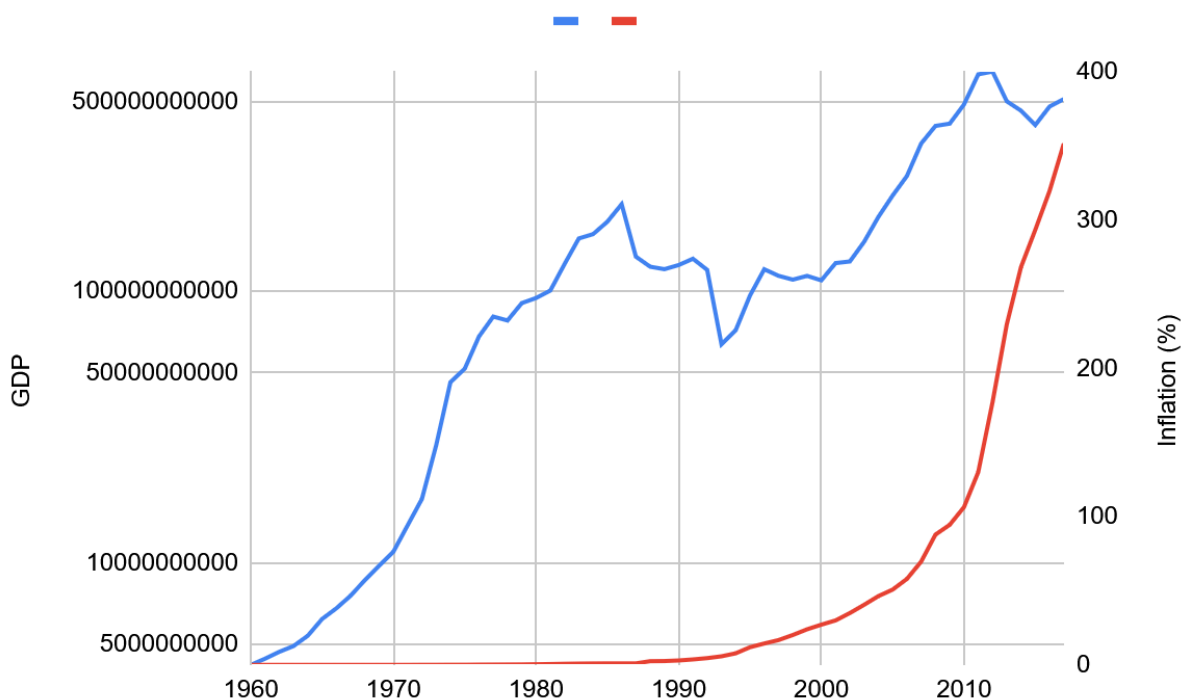


Figure 7 illustrates that sanctions produced sustained economic distress rather than a short-term disruption, as reflected in rising inflation alongside weakened growth performance. Using annual data on GDP growth and consumer price indices, I track how these macroeconomic indicators evolved in tandem with sanction episodes, allowing for a quantitative assessment of economic strain over time. The analysis shows that high inflation eroded real wages and household purchasing power, while stagnating or negative growth limited employment and intensified distributional pressures.

By connecting these observable trends to my research question, I show how structural vulnerabilities in Iran's economy translated into political pressure on decision-makers. Unlike a purely descriptive narrative, this approach quantifies the mechanisms through which sanctions affected both state revenue and private-sector activity, highlighting why economic pain became politically salient. In other words, Iran's economic structure transmitted costs upward into the political arena, creating stronger incentives for Tehran to negotiate and constrain aspects of its nuclear program under the JCPOA. This demonstrates that sanctions were effective not just in principle but in measurable, policy-relevant ways.

Taken together, the exchange-rate collapse and the inflation–growth trend illustrate how sanctions translated into economy-wide pressure rather than isolated disruption. The resulting instability reduced state revenue, increased public dissatisfaction, and raised the political costs of nuclear defiance, reinforcing the thesis argument that sanctions are most effective when they exploit structural vulnerabilities in globally embedded economies. Although Iran developed coping mechanisms, the scale and persistence of economic deterioration constrained the regime's strategic flexibility and strengthened incentives for bargaining.

### **Institutional Context and the Liberal International Order**

From a liberal institutionalist perspective, Iran's case illustrates the power of sanctions embedded within a broader international regime. UN authorization provided legitimacy, while coordination among the U.S., EU, and key allies reduced evasion opportunities. The sanctions regime functioned not merely as punishment but as leverage within a rules-based framework tied to the Non-Proliferation Treaty (NPT).

Ikenberry's analysis of the liberal international order is especially relevant here. Iran's exclusion from global financial and trade institutions underscored the costs of operating outside Western-dominated systems. Even alternative outlets through BRICS or regional partners could not replicate access to global capital markets, advanced technology, and institutional legitimacy. This supports the argument that partial separation from hegemonic systems may allow limited resistance, but at the cost of long-term economic vulnerability.

The JCPOA itself exemplifies liberal logic. Sanctions relief was conditional, monitored, and reversible, while compliance was verified by the IAEA. Iran's acceptance of intrusive inspections suggests that institutional mechanisms and reputational considerations mattered alongside material incentives.

This institutional embedding is also visible in observable behavior. In this study, I measure Iran's cooperation with the international regime by coding the frequency of IAEA inspections for each year, creating a longitudinal dataset that extends beyond what most prior studies have covered. Unlike existing literature, which often focuses on early 2000s events or the initial JCPOA period, my timeline incorporates inspections through 2023, including recent fluctuations in enforcement and engagement. By systematically tracking inspections alongside agreements, nuclear activity, and UN responses, I can analyze patterns of compliance over time and link them to periods of sanctions pressure and negotiation. This approach makes my contribution clear: I am not just summarizing prior findings, but providing new, structured data that allow empirical testing of the relationship between sanctions, institutional engagement, and policy behavior.

Figure 8: IAEA inspections 1984-2022

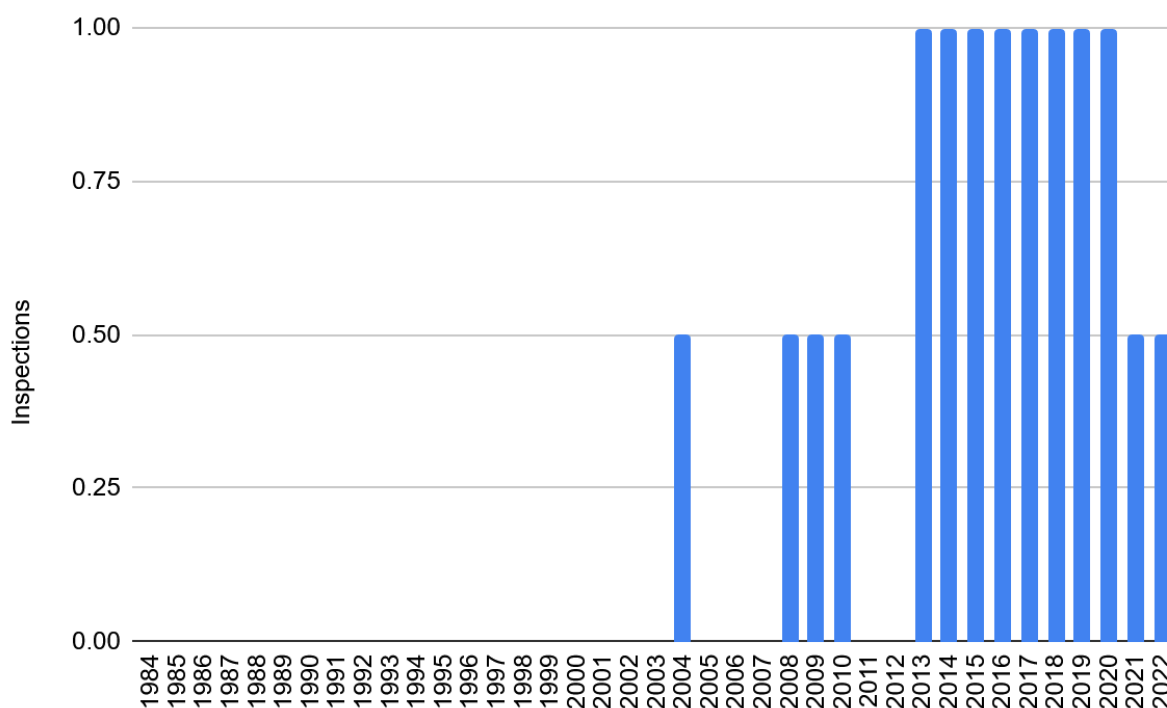


Figure 8 illustrates the number of International Atomic Energy Agency (IAEA) inspections conducted in Iran between 1984 and 2022, providing a concrete, measurable indicator of Iran's integration into international monitoring institutions. While prior literature emphasizes the role of inspections in shaping compliance (e.g., Mraz et al. 2016; Saikal 2006), most studies focus on the early 2000s or the JCPOA period. By compiling a yearly dataset that extends through 2022, I am able to analyze both the emergence and persistence of institutional engagement over a longer timeframe.

For most of the 1980s and 1990s, inspections were either absent or extremely limited, consistent with the literature's account of limited international scrutiny during this period. Beginning in the early 2000s, inspections became more frequent and regular, reflecting heightened concern over

uranium enrichment and Iran's obligations under the Non-Proliferation Treaty (NPT). My dataset demonstrates that this increase was not a one-time spike but part of a sustained pattern of institutional embedding, which I can systematically link to periods of sanctions escalation, formal agreements, and broader compliance behavior. In this sense, the analysis extends existing findings by providing structured, longitudinal evidence of how institutional engagement evolved over time and how it corresponded to economic and diplomatic pressures.

The most notable pattern appears after 2013, when inspections rise sharply and remain consistently high through the late 2010s. This period corresponds directly to the diplomatic negotiations that led to the Joint Comprehensive Plan of Action (JCPOA) and its implementation in 2015. Under the agreement, Iran accepted intrusive and routine verification measures, including continuous monitoring of facilities and expanded inspector access. The sustained peak in inspections during these years indicates not only formal compliance with the agreement but also Iran's willingness to operate within a rules-based framework in exchange for sanctions relief. In other words, the data show that sanctions were paired with institutional engagement, not isolation alone.

This trend provides evidence in support of the broader liberal institutionalist argument discussed in this chapter: rather than ignoring or rejecting international organizations, Iran strategically increased cooperation in response to economic pressure. Because the Iranian economy was highly dependent on access to global markets, foreign investment, and financial channels, the government faced incentives to signal credibility and compliance. The rise in IAEA inspections during periods of heightened sanctions and negotiations is not just descriptive; it offers observable behavioral evidence that economic vulnerability influenced policy choices, translating material constraints into institutional cooperation. In other words, the inspections data

directly link economic pressure to policy adjustment, showing that sanctions did more than inflict costs, they shaped how Iran engaged with international institutions, consistent with the economic vulnerability hypothesis central to this thesis.

More broadly, the figure highlights a key contrast that will later emerge in comparison with North Korea. Whereas Iran allowed repeated and sustained external monitoring, indicating a degree of openness to international rules, highly sanctioned but economically insulated states may instead restrict or expel inspectors. Iran's pattern suggests that when a state remains connected to the liberal international order, sanctions can push it toward deeper institutional engagement rather than defiance. The inspection record thus reinforces the chapter's central claim: sanctions were effective in the Iranian case not only because they imposed costs, but because they operated within a system of institutions capable of converting those costs into negotiated policy change.

### **Evidence for the Economic Vulnerability Hypothesis**

Iran's response to sanctions between 2010 and 2015 provides strong support for Hypothesis 1: the economic vulnerability hypothesis. Sanctions imposed substantial material costs, disrupted critical revenue streams, and generated domestic pressures that influenced elite decision-making. Unlike highly insulated regimes, Iran's leadership faced constraints imposed by public expectations, factional competition, and the need to sustain economic performance, illustrating how economic exposure translates into political consequences (Hypothesis 3: domestic politics hypothesis).

The JCPOA represents partial but meaningful compliance: Iran accepted limits on enrichment, reduced stockpiles, and allowed inspections, actions inconsistent with a purely security-driven

resistance model (Hypothesis 4: security dilemma hypothesis). While identity, sovereignty, and external threats mattered, they did not fully override economic considerations, consistent with Baldwin's logic of choice that sanctions function best when paired with credible diplomatic off-ramps. The eventual collapse of the JCPOA after U.S. withdrawal demonstrates how these conditions interact over time.

In sum, Iran's experience shows that sanctions influence nuclear behavior when a state is economically vulnerable, politically pluralized, and embedded, however uneasily, in global markets. Multilateral coordination and institutional legitimacy amplified these effects, while alternative economic partnerships only partially mitigated them (Hypothesis 2: regime resilience hypothesis). This case thus supports the structured set of four hypotheses introduced in Chapter 1 and sets the stage for comparison with North Korea in the next chapter.

### **Quantitative Analysis of Economic Effects in Iran**

Unlike the North Korean case, where unreliable official statistics required the use of indirect proxies for economic activity, Iran provides comparatively transparent and internationally reported macroeconomic data. This allows the analysis to move beyond approximation and directly test whether sanctions produced measurable economic strain consistent with the economic vulnerability hypothesis. Rather than relying on indirect proxies alone, this section combines electricity consumption data with macroeconomic indicators such as GDP per capita and trade openness to evaluate how sanctions affected Iran's economic capacity over time.

Because the theoretical expectation developed throughout this chapter is that sanctions are most effective when they exploit structural integration into global markets, the quantitative analysis focuses on variables that capture these channels of exposure. Electricity consumption per capita

serves as the primary dependent variable. Electricity use closely tracks industrial output, manufacturing activity, and household welfare, and is widely used in development economics as an indicator of overall economic performance. In contrast to North Korea, where energy data substitutes for missing national accounts, here electricity use complements available economic data, providing a behavioral measure of how economic disruptions materialized in production and consumption.

The key independent variables capture both external pressure and domestic fundamentals. International sanctions are coded as a binary indicator marking years with major multilateral restrictions on finance, oil exports, or trade. Sanctions intensity extends this measure by recording the degree of restriction on a 0–5 index, allowing the analysis to distinguish between limited and comprehensive episodes. Together, these variables test whether stronger economic pressure corresponds to larger declines in economic activity. Additional controls include GDP per capita and trade as a share of GDP, which capture overall economic development and the degree of international integration. Trade is particularly important in the Iranian case, as it reflects the country’s exposure to global markets and indirectly captures its reliance on oil exports. A binary nuclear-activity variable is also included to capture years of escalation that might independently influence international economic relations.

### **Dataset and Variables**

The dataset spans annual observations from the 1990 through 2023 and includes measures of economic activity, sanctions exposure, and structural economic characteristics. The dependent variable is electric power consumption per capita, measured in kilowatt-hours per person.

Electricity use captures fluctuations in industrial production, household consumption, and broader economic demand, and is widely used as an indicator of macroeconomic performance.

Independent variables include both political and economic controls. A binary international sanctions variable records years in which major multilateral or unilateral sanctions were imposed. To capture variation in intensity beyond a simple on/off indicator, a sanctions intensity index is also included, ranging from 0 to 5 based on the scope and severity of restrictions. A nuclear activity indicator is retained for consistency with the cross-case framework, although its expected effect remains ambiguous.

Compared to the initial specification, oil production and oil prices are excluded from the final model. This adjustment is both empirical and conceptual. Empirically, oil-related variables contain missing observations and reduce the available sample size, limiting degrees of freedom. Conceptually, oil is largely embedded within Iran's trade structure, as hydrocarbon exports constitute a substantial share of total trade. Trade as a percentage of GDP is therefore retained as a broader and more consistent measure of economic integration, capturing the primary channel through which sanctions affect the Iranian economy. This choice also improves comparability with the North Korea case, where oil data served as a proxy for external economic exposure in the absence of reliable trade data.

GDP per capita is included as a control for overall economic development, while trade as a share of GDP captures the degree of international integration. Together, these variables allow the model to isolate the independent effect of sanctions while accounting for structural economic conditions.

Table 9

Variable	Description	Unit
Energy Use per Capita	Energy use per capita	kWh/ capita
GDPpercapita	Economic output per person	current USD per capita
InternationalSanctions	1 = any major international sanction on Iran	Binary
Nucleartest	1 = nuclear test occurred	Binary
SanctionsIntensity	Degree of sanctions	index (0–5)
TradeofGDP	Total trade (exports + imports) as share of GDP	% of GDP

### Summary Statistics

Table 10 reports descriptive statistics for the Iranian dataset. Electricity consumption shows substantial variation over time, consistent with shifts in industrial activity and energy availability. Sanctions values are present in most years, reflecting the prolonged period of international pressure following the mid-2000s. Trade exposure also displays notable variation, underscoring Iran’s continued integration into global markets. This variation provides the statistical leverage necessary to identify relationships between sanctions and economic performance, while also reflecting the structural vulnerabilities emphasized throughout the chapter.

Table 10:

Variable	Mean	Standard Deviation	Minimum	Maximum
Electric power consumption	2151.61	849.45	908.40	3664.26
GDP per capita	3698.01	2023.83	1038.11	8114.08
International Sanctions	0.94	0.24	0	1
Nuclear Test	0.565	0.51	0	1

Sanctions Intensity	2.58	1.4'	0	5
Trade of GDP	43.71	6.37	29.23	56.62

### Model:

To evaluate whether sanctions exerted measurable economic effects, I estimate a series of OLS regressions with electricity consumption per capita as the dependent variable. The empirical strategy follows a stepwise approach, beginning with a baseline model and progressively adding controls to test the robustness of the results.

The baseline specification includes only sanctions and nuclear activity:

$$\text{Energy}_i = \beta_0 + \beta_1 \text{Sanctions}_i + \beta_2 \text{Nuclear}_i + u_i$$

Initial diagnostic tests revealed strong autocorrelation in this specification, as indicated by a Durbin–Watson statistic well below 2, suggesting positive serial correlation in the residuals, and a statistically significant Breusch–Godfrey test. Autocorrelation violates the assumption of independent errors and can bias statistical inference. To address this issue, a one-year lag of the dependent variable is introduced in subsequent models, creating a dynamic specification that accounts for temporal persistence in energy consumption.

The inclusion of the lag is justified both econometrically and substantively. Econometrically, it reduces serial correlation in the residuals. Substantively, economic responses to sanctions are not instantaneous; disruptions to trade, production, and consumption unfold over time. A lagged specification therefore provides a more realistic representation of how sanctions affect economic activity.

Additional variables are then introduced sequentially. Trade is added to capture economic openness and exposure to international markets, followed by GDP per capita and sanctions intensity to account for broader economic conditions and variation in the severity of sanctions.

The final specification is expressed as:

$$\text{Energy}_t = \alpha \text{Energy}_{t-1} + \beta_1 \text{Sanctions}_t + \beta_2 \text{Nuclear}_t + \beta_3 \text{Trade}_t + \beta_4 \text{GDP}_t + \beta_5 \text{SanctionsIntensity}_t + u_t$$

Although the inclusion of the lag substantially improves model performance, the Breusch-Godfrey test indicates that some autocorrelation remains. To ensure reliable inference, robust standard errors are used in the final specification, correcting for potential heteroskedasticity and serial correlation without altering coefficient estimates.

### **Results:**

Table 11 reports four regression models estimating the relationship between sanctions and electricity consumption per capita in Iran. Across specifications, the results indicate that sanctions are associated with reductions in economic activity, although the magnitude and interpretation of this effect change once temporal dynamics are introduced.

In the first regression, which mirrors the baseline specification used in the North Korea analysis, international sanctions are associated with a large and statistically significant decrease in electricity consumption (−1672 kWh per capita,  $p < .01$ ). Given the average consumption level of approximately 2,150 kWh, this represents a substantial effect. However, this model suffers from strong autocorrelation, as indicated by a low Durbin-Watson statistic (0.86) and a significant Breusch-Godfrey test, suggesting that the estimated relationship may be overstated.

In the second regression, a lagged dependent variable is introduced. The lag is highly significant and close to one, indicating strong persistence in electricity consumption over time. Once this temporal dynamic is accounted for, the magnitude of the sanctions coefficient decreases dramatically ( $-107$  kWh), although it remains statistically significant. This suggests that a large portion of the effect observed in the baseline model reflects underlying economic persistence rather than immediate causal impact.

The third regression introduces trade as a measure of economic openness. While trade is theoretically important, its coefficient is not statistically significant, indicating that variation in trade does not independently explain changes in electricity consumption once persistence is controlled for. However, its inclusion remains important for capturing Iran's structural integration into global markets and for maintaining consistency with the theoretical framework.

The final regression adds GDP per capita and sanctions intensity. Sanctions intensity is negative and statistically significant, indicating that stronger sanctions are associated with reductions in economic activity, even after controlling for broader macroeconomic conditions and temporal dependence. Substantively, this result reinforces the argument that the *severity* of sanctions matters for economic outcomes in Iran, consistent with the economic vulnerability hypothesis. In contrast, GDP per capita does not have a statistically significant independent effect, suggesting that general income levels do not independently drive changes in energy consumption once sanctions and dynamic effects are accounted for, likely due to overlap with other economic indicators in the model. Autocorrelation remains present according to the Breusch-Godfrey test ( $p = 0.002$ ), and robust standard errors are therefore applied to ensure valid inference.

Substantively, the magnitude of the key coefficients in the final specification suggests that sanctions imposed meaningful economic costs on Iran relative to the overall variation in electricity consumption. The sanctions intensity coefficient (-24.32) indicates that each one-unit increase in sanctions severity is associated with an estimated decline of approximately 24 kilowatt-hours per capita in electricity consumption. Given that sanctions intensity ranges from 0 to 5 and that the standard deviation of electricity consumption is 849.45, the cumulative effect of stronger sanctions becomes economically meaningful over time, particularly when combined with the persistence captured by the lagged dependent variable. Similarly, the nuclear test coefficient (52.13) suggests that years associated with nuclear escalation correspond to increases of roughly 52 kilowatt-hours per capita relative to non-test years, although this effect remains modest in comparison to the broader variation in energy consumption. By contrast, the lagged dependent variable coefficient (1.02) demonstrates extremely high persistence in electricity consumption over time, indicating that past economic conditions strongly shape future outcomes. Together, these magnitudes suggest that sanctions pressure affected Iran gradually rather than instantaneously, but nonetheless generated measurable economic strain within a highly integrated economy.

Overall, the results provide strong evidence that sanctions exert measurable economic pressure on Iran, particularly when accounting for their intensity. However, the inclusion of the lagged dependent variable demonstrates that economic adjustment occurs gradually and that baseline models may overstate the immediate impact of sanctions. Compared to North Korea, where sanctions effects were weak and statistically insignificant, the Iranian case shows clearer and more consistent economic disruption, supporting the economic vulnerability hypothesis.

Table 11:

Variable (n=32)	1st Regression	2nd Regression	3rd Regression	4th Regression
Energy use per capita				
Energy use per capita lagged		0.992907	0.9929052	1.024334
		(0.0138775)***	(0.143439)***	(0.148397)***
InternationalSanctions	-1672.403	-107.7478	-107.7496	
	(435.1429)***	(39.19091)***	(39.99478)**	
Nucleartest	1209.799	42.23102	42.22701	52.13097
	(207.7511)***	(22.42644)*	(23.54932)*	(24.26824)**
TradeofGDP			0.0010009	-1.11129
			-1.430703	-1.431224
GDPpercapita				-0.0000421
				(-0.0059796)
SanctionsIntensity				-24.31809
				(7.965717)***
Cons	3099.424	179.6242	179.5877	120.0181
	(407.0389)***	(51.0186)***	(73.63254)**	(61.1883)**
Note. Standard errors are in parentheses.				
***p < .01. **p < .05. *p < .10.				

3

<sup>3</sup> Because the dataset covers a relatively short time series, tests for serial correlation have limited power. While the inclusion of a lagged dependent variable improves the Durbin–Watson statistic, the Breusch–Godfrey test still indicates residual autocorrelation. Results should therefore be interpreted with some caution, although the direction and significance of key coefficients remain stable across specifications.

Taken together, these findings reinforce the central theoretical argument of this thesis. While some control variables do not exhibit independent statistical significance, sanctions intensity remains consistently associated with reductions in economic activity, indicating that the severity of external pressure matters more than baseline economic conditions alone. More importantly, the contrast with North Korea highlights the role of structural economic integration: whereas sanctions had limited measurable effects in a highly autarkic system, Iran's openness created channels through which economic pressure could translate into observable outcomes.

These results therefore provide strong quantitative support for Hypothesis 1, demonstrating that sanctions are more effective when imposed on economies that are structurally integrated into global markets. In the Iranian case, trade linkages and dependence on external economic flows created vulnerabilities that sanctions were able to exploit, reducing economic activity and increasing the costs of continued nuclear defiance.

Overall, the Iranian case demonstrates how economic sanctions can translate into meaningful policy outcomes when imposed on a state that is structurally integrated into the global economy. Both the qualitative analysis and the quantitative results point to the same conclusion: sanctions generated significant economic strain, which in turn created political incentives for negotiation and partial compliance. While these effects were neither immediate nor absolute, they were sufficient to influence Iran's nuclear trajectory, particularly when combined with multilateral coordination and institutional engagement.

This stands in sharp contrast to the North Korean case, where limited economic integration constrained the transmission of external pressure. Taken together, the two cases highlight the central argument of this thesis: the effectiveness of sanctions depends not only on their design or

intensity, but on the structural characteristics of the targeted economy. The following chapter builds on this insight by directly comparing Iran and North Korea to explain why similar sanctions strategies produced divergent outcomes.

## **Chapter 4: Comparative Analysis and Implications**

### **Comparative Analysis: Why Sanctions Worked in Iran but Not in North Korea**

The preceding chapters examined Iran and North Korea as two critical tests of the four hypotheses developed in Chapter I, each rooted in competing traditions of international relations theory. While the economic vulnerability hypothesis reflects a realist emphasis on material constraints, the security dilemma hypothesis also draws on realist logic by emphasizing how perceived threats drive nuclear escalation; the domestic politics hypothesis draws on liberal insights about internal political mediation, and the regime resilience hypothesis incorporates constructivist attention to identity and legitimacy. Although both states faced sustained international sanctions aimed at constraining nuclear development, their behavioral responses diverged sharply. Iran ultimately accepted meaningful limits on its program under the Joint Comprehensive Plan of Action (JCPOA), while North Korea continued testing, withdrew from negotiations repeatedly, and expanded its arsenal. This contrast provides an opportunity to evaluate how these theoretical mechanisms, material pressure, domestic institutions, and identity-based resistance, explain variation in sanctions effectiveness.

At the most basic level, the two economies occupy opposite positions on the spectrum of global integration. Iran, despite its revolutionary ideology and adversarial relationship with the West, remained deeply embedded in international markets. Oil exports financed the state budget, trade

constituted a substantial share of GDP, and access to foreign banking and hard currency was essential for both public and private sectors. Sanctions targeting these chokepoints, particularly oil sales and financial networks such as SWIFT, therefore translated directly into macroeconomic stress. The empirical analysis in Chapter III (Iran case study) demonstrated that sanctions corresponded with declines in electricity consumption, currency depreciation, inflation, and reduced growth, indicating that economic pressure penetrated core sectors of the economy.

North Korea, by contrast, entered the sanction period already highly autarkic. Trade exposure was limited and concentrated in a small number of partners, particularly China. Domestic production relied less on global finance and more on state-controlled distribution systems. Because fewer channels connected the economy to the international system, sanctions had fewer mechanisms through which to transmit pressure. Quantitative proxies for economic performance showed far weaker responses to sanction episodes, suggesting that material constraints did not accumulate to the same degree as in Iran.

*Political institutions* amplified these structural differences. Iran's hybrid regime includes competitive elections, factional rivalries, and a semi-open public sphere. Economic downturns therefore generated politically salient consequences. Inflation, currency collapse, and unemployment directly affected urban middle classes, merchants, and industrial sectors that possessed some influence within the political system. These pressures strengthened pragmatic factions advocating diplomatic compromise and contributed to the electoral victory of President Hassan Rouhani in 2013. In this way, sanctions operated indirectly through domestic politics, converting economic costs into bargaining incentives.

North Korea's political system is far more centralized and insulated. Power is concentrated within the ruling family and the security apparatus, while dissent is suppressed through surveillance and coercion. Even severe economic hardship does not translate into organized political pressure capable of influencing policy. As a result, sanctions fail to produce the internal contestation necessary for policy change. Economic pain remains socially diffuse rather than politically mobilizing.

*Institutional embeddedness* further distinguishes the two cases. Iran remained a member of the Non-Proliferation Treaty and allowed extensive monitoring by the International Atomic Energy Agency. Inspections, negotiations, and UN resolutions created repeated opportunities for diplomacy. Sanctions were thus paired with credible pathways for relief, enabling a “carrots and sticks” dynamic consistent with liberal institutionalist theory. North Korea, in contrast, withdrew from the NPT and expelled inspectors, reducing both transparency and leverage. Without institutional channels linking sanctions to negotiated rewards, coercion alone provided little incentive for compliance.

Taken together, the comparison reveals a consistent pattern across the theoretical frameworks. The economic vulnerability hypothesis is supported, but it operates through both realist and liberal logics: from a realist perspective, sanctions function as coercive tools that impose material costs on states, while liberal theory highlights that economic interdependence creates structural exposure that translates external pressure into domestic economic strain. Sanctions are therefore more effective where states are integrated into global markets and dependent on trade, finance, or resource exports. The domestic politics hypothesis, grounded primarily in liberal theory, explains how these external pressures are mediated through internal institutions, elite bargaining, and political constraints, producing policy adjustment in Iran but not in North Korea, where political

power is highly centralized and insulated from societal pressure. Finally, the regime resilience hypothesis, informed by constructivist insights, clarifies why North Korea is able to absorb and reinterpret external pressure through ideological legitimacy and identity-based narratives, reinforcing resistance rather than compliance. Sanctions are therefore most effective where material vulnerability, domestic political mediation, and institutional openness align, and least effective where regimes are economically insulated, politically closed, and ideologically resistant.

### **Discussion: Theoretical and Policy Implications**

These findings offer support for the economic vulnerability hypothesis, which draws on both realist and liberal traditions. From a realist perspective, sanctions function as coercive instruments that operate by increasing the material costs of non-compliance, thereby constraining state behavior when those costs become sufficiently high. At the same time, liberal theories of economic interdependence help explain why these costs are unevenly distributed across states: greater integration into global markets increases sensitivity to external economic pressure and creates structural channels through which sanctions can be transmitted.

Sanctions therefore do not operate uniformly across targets; their effectiveness depends on the degree of exposure to global trade, finance, and resource dependency. Economic openness generates both benefits under normal conditions and vulnerabilities under coercion, making some states more responsive to external pressure than others. In this sense, the findings are consistent with the expectation that material constraints matter, but they are also consistent with liberal arguments that interdependence shapes the conditions under which coercion becomes effective.

The cases also demonstrate that material pressure alone is insufficient, highlighting the importance of the domestic politics hypothesis and its grounding in liberal theory. Economic shocks must interact with political structures capable of translating costs into decisions. Iran's factional politics and electoral institutions allowed economic grievances to influence leadership choices, whereas North Korea's totalitarian structure blocked this transmission. This supports the liberal view that states are not unitary actors, but are shaped by internal institutions and competing interests. Sanctions are therefore most likely to succeed in systems that are politically responsive enough to transmit pressure, but not so insulated that leaders can ignore it entirely.

From a policy perspective, the comparison highlights the importance of targeting in future non-proliferation strategies. Broad trade embargoes are generally less effective than more precise measures directed at financial chokepoints, energy exports, and access to international currency markets. Iran's experience suggests that restricting oil revenues, banking transactions, and access to global payment systems can generate significant fiscal pressure in states that are integrated into global energy and financial networks. By contrast, North Korea's limited exposure to international markets significantly reduced the effectiveness of similar sanctions, as alternative channels of financing and external support helped offset economic pressure.

For future proliferation cases, this implies that sanction design should be calibrated to the structure of the target economy. In economically integrated states, such as energy exporters or export-dependent manufacturing economies, sanctions on strategic revenue sectors (oil, gas, major commodity exports, and international banking access) are likely to produce more meaningful leverage. In more isolated or autarkic regimes, effectiveness is likely to depend less on economic pressure alone and more on complementary tools such as diplomatic isolation, interdiction of illicit networks, and coordination with third-party suppliers or patron states. This

suggests that sanctions are most effective when they directly disrupt the specific external linkages that sustain state revenue and foreign exchange capacity, rather than relying on broad-based economic restrictions.

At the same time, the Iranian case demonstrates that sanctions work best when paired with credible diplomatic off-ramps. The JCPOA provided a clear exchange: compliance in return for relief. Without such incentives, sanctions risk entrenching resistance rather than encouraging negotiation. Coercion and engagement are thus complementary rather than contradictory strategies.

Alternative explanations receive more limited but still important support when viewed through an international relations lens. A purely realist security-driven account, reflected in the security dilemma hypothesis, would predict persistent resistance in both cases, yet Iran accepted intrusive inspections despite ongoing external threats. Constructivist explanations centered on identity and ideology help explain North Korea's continued defiance, but they do not fully explain why Iran's policy changes occurred at specific moments of acute economic strain. These findings suggest that while security concerns and identity narratives matter, they are most influential when interacting with, rather than replacing, underlying material conditions.

### **Policy Implications:**

The preceding chapters evaluated sanctions effectiveness through both qualitative process tracing and quantitative indicators, including trade dependence, energy consumption, GDP growth, and exposure to international financial systems. If the economic vulnerability hypothesis is correct, these variables should not only explain past behavior but also help anticipate future outcomes. States that remain economically integrated and dependent on external revenue should continue to

experience measurable macroeconomic stress under sanctions, creating incentives for negotiation or partial compliance. By contrast, states that are already insulated from global markets should exhibit weaker economic responses and correspondingly lower political sensitivity to coercion. Recent developments in both Iran and North Korea provide an opportunity to evaluate whether these relationships persist in the contemporary period.

### **Iran: Escalation, Strikes, and Renewed Bargaining:**

Since 2020, sanctions on Iran have intensified across oil exports, petrochemicals, financial institutions, and procurement networks linked to missile and drone production (Council on Foreign Relations 2026). The United States has continued variations of its “maximum pressure” strategy by targeting oil brokers, shipping companies operating the so-called shadow fleet, and intermediaries that facilitate crude sales abroad (Reuters 2026). At the multilateral level, the collapse of the Joint Comprehensive Plan of Action reopened the door for renewed penalties coordinated through the United Nations. These economic measures have periodically been paired with regional military escalation and reported strikes on nuclear-linked infrastructure (CNN 2026; Reuters 2026).

Unlike highly isolated regimes, Iran remains deeply tied to global markets. Oil revenue, foreign exchange access, and trade flows are central to fiscal stability. As a result, sanctions translate directly into domestic hardship. Inflation has repeatedly exceeded 35–40 percent, the rial has depreciated sharply, and shortages of foreign currency have constrained imports and industrial production (Council on Foreign Relations 2026).

Yet these costs have not produced unconditional compliance. Instead, Iran has resumed uranium enrichment, expanded centrifuge capacity, rebuilt facilities, and limited inspections while simultaneously signaling openness to talks (The New York Times 2026; Al Jazeera 2026).

The result is a cyclical dynamic: sanctions create economic and fiscal hardship, which in turn generates domestic and elite pressure for negotiation. Nuclear advancement, however, can restore or enhance a state's bargaining power, allowing the regime to extract concessions or partial agreements from external actors. These temporary or partial agreements often do not fully resolve underlying disputes, and sanctions may resume once compliance falters or political priorities shift. Recent reconstruction at enrichment sites reported in 2026 and intermittent diplomatic outreach fit this logic closely (Reuters 2026), illustrating that sanctions-induced cycles are rarely linear. This pattern also highlights how state strategies, domestic political considerations, and international negotiations interact, producing repeated oscillations between coercion, compromise, and renewed nuclear development.

### **North Korea: Institutional Isolation and Persistent Expansion**

The trajectory in North Korea is markedly different. Recent sanctions have increasingly shifted away from traditional trade restrictions toward attempts to disrupt the regime's adaptive survival mechanisms. These include targeting illicit oil transfers, cyber-enabled financial operations, cryptocurrency theft, and networks linked to expanding military cooperation with Russia (Council on Foreign Relations 2026). The rationale behind this shift is that earlier sanctions on formal trade channels, such as coal, textiles, arms, and energy exports, became less effective over time as the DPRK developed alternative revenue streams outside the formal economy.

As a result, more recent measures aim to constrain the regime's ability to generate hard currency through informal and transnational channels, particularly cyber operations and sanctions evasion networks that bypass conventional trade restrictions. The United States and its partners have therefore focused on sanctioning individuals and entities connected to ballistic missile development and logistics networks, in an effort to increase the cost and complexity of maintaining weapons programs. However, enforcement capacity has weakened in practice, as divisions within the United Nations have reduced coordination and undermined monitoring mechanisms, limiting the overall effectiveness of these measures.

Despite these restrictions, the economic impact has been limited. North Korea's economy was already largely autarkic before most sanctions were imposed. Trade dependence on global markets is minimal and concentrated among a small number of partners, while financial isolation long predates current measures. Consequently, additional sanctions remove relatively little marginal revenue. The transmission channels that create pressure in Iran, such as currency instability, business losses, and consumer inflation, are muted or absent.

Security developments reinforce this resilience. Reporting summarized by the U.S. Naval Institute, drawing on congressional assessments, indicates continued qualitative and quantitative expansion of fissile material production and missile technology, including new solid-fuel systems and multiple rocket launchers (France 24 2026; CNN 2026). The regime has advanced solid-fuel intercontinental ballistic missiles, submarine-launched systems, and diversified delivery platforms. Leadership statements consistently frame nuclear weapons as essential to regime survival and reject denuclearization talks outright.

Political institutions further insulate the regime from pressure. Centralized control, repression, and dynastic succession signaling reduce the likelihood that economic hardship translates into organized dissent. Because regime survival depends more on internal coercion than economic performance, sanctions provide little leverage over strategic decisions. Rather than bargaining under pressure, Pyongyang continues steady weapons development punctuated only by tactical negotiations aimed at extracting aid or recognition.

### **Comparative Implications: Why Sanctions Diverge in Effectiveness**

Placing the two cases side by side highlights the conditional nature of economic coercion. Both states face extensive sanctions, yet their responses diverge sharply. Iran oscillates between escalation and negotiation, while North Korea sustains uninterrupted nuclear expansion. The difference lies not in sanction intensity but in a combination of economic and domestic political structure. Iran's integration into global markets makes sanctions economically and socially costly, creating recurring incentives for compromise. At the same time, its more pluralistic and factionalized domestic political system generates internal bargaining dynamics that allow external economic pressure to be translated into policy debate and periodic diplomatic engagement. By contrast, North Korea's structural economic isolation limits the transmission of external pressure, while its highly centralized political system prevents domestic contestation that could convert economic strain into policy change. Where market exposure and domestic political pluralism exist, sanctions can create bargaining opportunities; where both economic and political insulation are present, sanctions primarily signal disapproval without significantly altering behavior. A remaining question is whether Iran would continue to be responsive if it acquired nuclear weapons. While nuclear capability could strengthen Iran's bargaining position and deterrence capacity, its continued economic integration and internal political dynamics

suggest that sanctions would still impose significant costs, making complete resistance difficult and partial compliance more likely.

Taken together, contemporary developments reinforce the central claim of this thesis: sanctions are most effective when they exploit existing economic vulnerabilities. They can shape the choices of moderately integrated regimes like Iran, but they struggle to influence highly autarkic and institutionally insulated states like North Korea. The contrasting trajectories observed since 2020 therefore confirm that coercive economic tools generate conditional compliance in some contexts and persistent defiance in others, not because of policy failure, but because of underlying structural differences.

### **Conclusion:**

This thesis began with a simple but contested question: do sanctions influence nuclear behavior, and if so, under what conditions? By integrating realist, liberal, and constructivist perspectives through four testable hypotheses, this study demonstrates that no single theory fully explains sanctions outcomes in isolation. Instead, sanctions effectiveness emerges from the interaction between material vulnerability (realism), domestic political mediation (liberalism), and regime identity and legitimacy (constructivism). The comparison of Iran and North Korea shows that sanctions are neither inherently effective nor inherently futile, but conditionally effective depending on how these theoretical mechanisms align within a given state.

The evidence shows that sanctions exert influence when they can penetrate core sectors of an economy and when political institutions transmit economic costs into policy decisions. Iran's dependence on oil exports, foreign currency, and global markets created precisely these vulnerabilities. Economic disruption translated into domestic political pressure, strengthening

factions willing to negotiate and producing partial compliance through the JCPOA. North Korea lacked these channels. Its limited integration, centralized control, and emphasis on regime survival insulated decision makers from economic pain. As a result, similar coercive measures produced far weaker behavioral change.

The forward-looking analysis confirms that these mechanisms continue to operate today. Recent sanctions and military pressure have generated persistent economic strain in Iran and renewed bargaining, while North Korea has expanded its arsenal despite intensified restrictions. These contemporary developments strengthen the thesis's central claim that economic structure shapes sanction effectiveness more than ideology or rhetoric alone.

Beyond explaining two important cases, the findings carry broader implications for policy design. Sanctions are most likely to succeed when they target financial chokepoints, energy revenues, and trade networks that governments cannot easily replace, and when they are paired with credible diplomatic pathways for relief. Where regimes are highly insulated or autarkic, alternative strategies such as security guarantees, regional diplomacy, or long-term engagement may be necessary. Treating sanctions as a universal solution risks both humanitarian harm and strategic disappointment.

Several avenues for future research follow naturally from this study. Expanding the analysis to additional nuclear or near-nuclear states could test whether the economic vulnerability framework generalizes beyond these two cases. Incorporating leadership succession dynamics, such as the potential hereditary transition in North Korea, may clarify how regime continuity affects sensitivity to external pressure. More granular economic data, including firm-level trade networks or subnational energy consumption, could further identify specific vulnerabilities.

Finally, combining cross-national statistical models with detailed case studies would strengthen causal inference and allow scholars to refine predictions about when sanctions will succeed.

Ultimately, the core lesson of this thesis aligns with a more integrated view of international relations theory. Sanctions do not operate in a vacuum; they work through the economic structures emphasized by realism, the institutional channels highlighted by liberalism, and the identity dynamics central to constructivism. Understanding how these dimensions interact allows policymakers to anticipate outcomes more realistically and design more effective strategies. By shifting the question from whether sanctions work to when and why they work across different theoretical contexts, this study contributes a more nuanced and practically useful framework for addressing nuclear proliferation in an increasingly complex international system.

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