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Conventional Military Modernization in China and India: A Comparative Historical Analysis

A dissertation submitted to the Graduate School
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Abstract

This dissertation examines China's and India's military modernization since 1980 demonstrated by advancements in major weapons systems. It examines the impact of four key variables on military modernization—two demand-side variables, i.e. the security threat environment and the obsolescence of existing military forces, and two supply-side variables, i.e. military industrial capacity and the availability of foreign suppliers. This study argues that in periods when most of the explanatory variables, as determined by several indicators, are measured high, particularly security factors and military obsolescence, military modernization is highest. Moreover, the security threat environment plays a larger role in influencing military modernization in both states than previously understood. Additionally, China's rapid advancement ahead of India, despite disadvantages, may be a result of alternative means of procurement and development, to include not only aggressive means of technology transfer through co-option, coercion, and industrial espionage.

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Chapter I

Introduction

Since the end of the first Persian Gulf War in 1991, considerable research and commentary has been dedicated to a revolution in military affairs (RMA) due to the technological leap in United States (US) military modernization. This discussion renewed research—albeit disproportionately—in rising developing states and their respective military modernization programs. Technology and funding alone, however, do not drive the complex process of military modernization. This study broadens the analysis of military modernization by examining the influence of four variables and further develops unique observations of the Sino-Indian rivalry.

Since 1980, China and India have pursued extensive modernization of their armed forces and have established themselves as rising powers in the international community.[1] China's modernization has undergone a quantitative and qualitative transformation involving a systematic reorganization of its entire force structure. India has also substantially modernized its armed forces. This modernization in both countries, however, has not been consistent across time periods—it is greater in some time periods and lesser in others.[2] What factors explain these patterns of increased and lower volumes of military modernization at various points in time? The literature on military modernization in regional powers does not adequately examine this question. This dissertation identifies four key variables that influence military modernization in

[1] Richard A. Bitzinger, "Comparing Defense Industry Reforms in China and India," *Asian Politics & Policy*, Vol. 7, No. 4 (October 2015): pp. 531-553.

[2] Richard A. Bitzinger, "Defense Industry Reform in China and India: Similar Starting Points, But Wildly Divergent Paths," *China-India Brief*, No. 36 (Centre on Asia and Globalization; September-October 2014); and Oriana Skylar Mastro and Arzan Tarapore, "Asymmetric but Uneven: The China-India Conventional Military Balance," in Kanti Bajpai, Selina Ho, Manjari Chatterjee Miller, ed., *Routledge Handbook of China-India Relations*; (London: Routledge, 2020).

China and India. These are military industrial capacity, available foreign supply, military obsolescence, and the security threat environment; their values were relatively high, medium, or low in various time periods analyzed in this study. Through eight time periods from 1980 to 2018, the dissertation demonstrates that military modernization was high when combinations of the above variables are highest.

This dissertation defines and measures military modernization by an estimated expenditure in major weapons systems (MWS), which are either developed indigenously or procured from foreign states. These figures then provide an estimated value of low, moderate, or high based on approximate totals for each period. The variables that influence military modernization are outlined with their respective indicators in Table 1.1 below. The indicators are evaluated by a defined set of parameters, which are outlined in Chapter 2, and then categorized as low, moderate, or high. Some indicators, such as defense policy reforms and the existence of import-substitution policies are categorized differently to better reflect their significance. Together, each set of indicators contributes to an overall assessment (categorized as low, moderate, or high) of each variable and its estimated impact on military modernization.

Table 1.1: Variables & Indicators Contributing to Military Modernization
Measured from 1980-2018

Variables	**Military Industrial Capacity**	**Available Foreign Supply**	**Military Obsolescence**	**Security Threat Environment**
Indicators	Gross Domestic Product	Arms Embargoes	Block Obsolescence of Force Structures	Composite Measure of National Capabilities
	High-technology Exports	Import-substitution Policies	Military Technological Obsolescence	Regional Instability
	Gross Tertiary Education Enrollment	Nature of Defense Trade Relationships		Changes in Opponent Capabilities
	Defense Research & Development			

	Expenditure	
	Defense Policy Reforms	

Ultimately, this dissertation finds that military modernization intensified and heightened when combinations of the above variables were categorized high according to their respective indicators. Among these variables, major changes in the security threat environment were particularly significant, as was the case in India following a nuclear standoff with Pakistan in the late-1990s, and in China following escalation over Taiwan in the mid-1990s.

1.1 Overview of Military Modernization Assessments

In India, during the period 1980 to 1984, military modernization was moderate and near high corresponding with a high and unstable security threat environment and high favorable arms supply. In the period 1985 to 1989, military modernization was low at a time of a moderate security threat environment, moderate military obsolescence, and moderate foreign supply. This drop occurred at a time of low military industrial capacity and reduced concerns about the security threat environment. In the period 1990 to 1994, military modernization was low when there was low military industrial capacity and moderate foreign supply. Likewise, marginal improvements in the security threat environment contributed to reduced demand for military modernization. In the period 1995 to 1999, military modernization remained low at a time of low-moderate availability of foreign suppliers and high security threat environment. In the period 2000 to 2004, military modernization was moderate and near the high threshold at a time of high levels of military obsolescence and high security threat environment. In the period 2005 to 2009, military modernization remained high when there were moderate levels of military industrial capacity and high availability of foreign suppliers. In the period 2010 to 2014, military modernization was high when there was a moderate-high security threat environment and high military obsolescence, while moderate military industrial capacity was mitigated by high foreign arms supply. Finally, in the period 2015 to 2018, moderate-high security threat environment considerations and high military obsolescence corresponded with high military modernization.

The India case reveals several variations and interactions. First, India's rivalry and conflicts with Pakistan drove its security threat environment considerations and subsequently its military modernization. While India possessed quantitative advantages on many fronts, it could not afford to yield qualitative advantages in the form of advanced MWS to Pakistan, which also possessed wide access to major foreign arms suppliers, including the US, Soviet Union/Russia, and later China. Second, foreign arms procurement was further driven by military obsolescence and military industrial capacity considerations. At various times, the high security threat and creeping military obsolescence created a demand for MWS modernization, but indigenous supply was not possible due to inadequate military industrial capacity, and this influenced defense planners to seek foreign weapons. Third, India's self-imposed import-substitution policies (thus affecting foreign arms supply) conflicted with its aspirations for military self-sufficiency. Foreign technology acquisition and assimilation are imperative to expanding military industrial capacity, and defense innovation. While India had an extensive program of foreign arms procurement, it did not have a clear program for incorporating foreign technology into its own military industrial complex.

In China, in the period 1980 to 1984, military modernization was low at a time of low military industrial capacity and low concerns about the security threat environment. In the period 1985 to 1989, military modernization was low under these same conditions. Between 1990 and 1994, however, military modernization was moderate when there was moderate availability to foreign arms supply and, though low, marginally increased concerns about the security threat environment. In the period 1995 to 1999, military modernization was moderate and corresponded with a combination of high military obsolescence and high security threat environment considerations. From 2000 to 2004, military modernization was high at a time of moderate military industrial capacity, high military obsolescence, and moderate-high security threat environment considerations. In the period 2005 to 2009, military modernization was high from a combination of high military industrial capacity, high military obsolescence, and moderate security threat environment. In the period 2010 to 2014, China's military modernization was very high at a time of both high military industrial capacity and moderate-high military obsolescence. Finally, in the period 2015 to 2018, modernization was high at a time of high military industrial capacity, moderate military obsolescence, and a moderate-high security threat environment.[3]

The China case also has key variations and interactions. First, China's assessment of a non-threatening security threat environment in the late-1970s and early 1980s had a significant impact on military obsolescence and military industrial capacity. Ironically, China had access to several Western arms suppliers in the 1980s but likely did not maximize those relationships, instead opting to focus on economic development. De-emphasis on military modernization thus meant a reduction in military industrial capacity and higher acceptance of military obsolescence during this period. Second, following the Tiananmen Square crisis in 1989 and the US demonstration of RMA capability in the Persian Gulf War, changes in military obsolescence (increasing), available foreign suppliers (decreasing), and the security threat environment (increasing) influenced the need for enhanced military industrial capacity. China was fortunate

[3] These observations demonstrate that the sharpest shifts in military modernization followed major international events, including the Tiananmen Square crisis, the Persian Gulf War, the Third Taiwan Strait crisis, and the US invasions of Iraq and Afghanistan.

that its defense dividend paid off in the 1990s by providing increased financial resources, as well as new international business relationships, to then invest in military industrial capacity. As a result, some of China's most significant defense policy reforms were observed in the 1990s. Third, developments in China have an impact on India. China's recent substantial increases in military industrial capacity, and subsequently military modernization as a whole, almost certainly influenced India's security threat environment considerations and a re-evaluation of the need to increase its own military industrial capacity. Disputes along the Sino-Indian border and China's encroachment into the Indian Ocean have further highlighted some of the dynamics of this renewed rivalry contributing to changes in India's defense policies. For example, India has adjusted its import-substitution policies, increased R&D, and deepened its relationship with the US as one of its top arms suppliers, to include various transfers of weapons technology.

As these two cases demonstrate, the variables in relation to military modernization vary across time periods. Likewise, the dynamics and relationships between the variables also change, sometimes altering the relative significance of each other at certain times. These along with additional observations are examined further in later chapters.

The next section of this chapter addresses the importance of this study. This is followed by a review of the literature on military modernization in regional powers and Less Developed Countries (LDCs), including China and India (who were considered LDCs in the 1980s-1990s but are considered established rising powers since then). The chapter concludes with an overview of alternative explanations for military modernization.

1.2 Why Study Military Modernization in China and India?

The study of China and India's military modernization is important for three reasons. First, China and India have a history of conflict, continue to dispute several flashpoint issues, and have made military modernization an issue of national prestige.[4] The unresolved Sino-Indian border—over which the two sides went to war in 1962—is still a major source of tension between the two countries.[5] While China peacefully settled some border disputes, it has a history of using military force to settle conflicts.[6] Despite the 2003 Declaration on Cooperation and several rounds of diplomatic talks between China and India, both sides remain entrenched in their contrasting positions about their disputed border. Illustrating this, they engaged in military standoffs along the Himalayan border in Doklam (Bhutan) in 2017 and Ladakh in 2020. In addition, domestic political pressures make it difficult for India's government to ignore Chinese incursions into Indian territory. The presence of over 100,000 Tibetan refugees in India also remains an issue underscoring this dispute.

Another concern is their increasingly overlapping and conflicting spheres of interests, especially in the realm of natural resources.[7] Competition for energy and water resources is a

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[4] John W. Garver, *Protracted Contest: Sino-Indian Rivalry in the Twentieth Century* (Seattle, WA: University of Washington Press, 2001); David Kinsella and Jugdep S. Chima, "Symbols of Statehood: Military Industrialization and Public Discourse in India," *Review of International Studies*, Vol. 27, No. 3 (July, 2001), pp. 353-373; and Bibek Chand, "Dynamics of Rivalry between Geographically Contiguous Regional Powers: The Case of Sino-Indian Competition," *Asian Politics & Policy*, Vol. 11, No.1 (2019), pp. 123-143.

[5] See for instance William W. Bain, "Sino-Indian Military Modernization: The Potential for Destabilization," *Asian Affairs* Vol. 21, No. 3 (Fall 1994), pp. 131-147; and Aaron L. Friedberg, "Ripe for Rivalry: Prospects for Peace in Multipolar Asia," *International Security* Vol. 18, No. 3 (Winter 1993-1994), pp. 5-33.

[6] M. Taylor Fravel, "Power Shifts and Escalation: Explaining China's Use of Force in Territorial Disputes," *International Security*, Vol. 32, No. 3 (2008), pp. 44-83.

[7] David Scott, "Sino-Indian Security Predicaments for the Twenty-First Century," *Asian Security* Vol. 4 No. 3 (September 2008), pp. 244-270.

serious flashpoint.[8] The Himalayan mountains are the primary source of water in the region, and China's damming and rerouting of rivers could lead to conflict. In addition, the Indian Ocean and major Asian shipping lanes will expand as an area of contention with the growth of both states' economies and naval fleets.[9]

Second, balance of power and security stability is essential to US interests in the Asia-Pacific region. China's military modernization is tied to its pursuit of hegemony in the Asia-Pacific region, also called the Indo-Pacific region, potentially destabilizing the region.[10] Specifically, the US Department of Defense stated that "China continues its economic and military ascendance, asserting power through an all-of-nation long-term strategy, it will continue to pursue a military modernization program that seeks Indo-Pacific regional hegemony in the near-term and displacement of the United States to achieve global preeminence in the future."[11] Conversely, India's great power ambitions are of no threat to the US and instead support its interests—more military modernization in a US-friendly India would support US interests of maintaining a power balance against China in the Asia-Pacific.[12] This relationship has been

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[8] See for example Brahma Chellaney, *Water: Asia's New Battleground* (Washington, D.C.: Georgetown University Press, 2011).

[9] Robert D. Kaplan, *Monsoon: The Indian Ocean and the Future of American Power* (New York: Random House, 2010); David Brewster, "China-India and Maritime Security: A Contest for Power and Influence in the Indian Ocean," in Kanti Bajpai, Selina Ho, Manjari Chatterjee Miller, ed., *Routledge Handbook of China-India Relations*; (London: Routledge, 2020).

[10] U.S. Department of Defense, *Summary of the National Defense Strategy of the United States of America: Sharpening the American Military's Competitive Edge* (Washington, D.C.: U.S. Department of Defense, 2018), pp. 2-3.

[11] Ibid, p. 2.

[12] *Why the US Promotes India's Great-Power Ambitions*, Aspects of India's Economy, No. 41 (Mumbai, India: Research Unit for Political Economy (R.U.P.E.), December 2005); and Office of the Secretary of Defense for Net Assessment, *Indo-US Military Relationship: Expectations and Perceptions* (Washington, D.C.: US Department of Defense, 2002), p. 20.

reinforced through arms sales, military exercises, technology transfer, and foreign direct investment.[13] The US and India also signed a logistics supply agreement in 2016 and the Communications, Compatibility and Security Agreement (COMCASA) in 2018.[14] Reinforcing this point, various US governmental reports clearly indicate that China's military modernization is one of the principal reasons for the US military-security focus on Asia, and India may be an effective counter-balance.[15]

Third, other Asian states are deeply interested in maintaining stability in the region and realize that the military capabilities in China and India are central to that goal. According to one analyst, "for some ASEAN states, greater interaction with India could help dilute Chinese influence in line with the organization's philosophy of engaging all interested powers and not being dominated by any single hegemon."[16] In terms of active balancing, some states like Pakistan are looking to China to hedge against India. During a time of Pakistan-US tensions in 2011, Prime Minister Yusuf Raza Gilani told a Chinese delegation "Pak-China friendship is higher than mountains, deeper than oceans, stronger than steel and sweeter than honey."[17] Other states are looking towards India to counter China's growing power. This has culminated into a

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[13] US arms sales to India are worth about $15 billion from the early 2000s to the mid-2010s.

[14] Jeff Smith, "COMCASA: Another Step Forward for the United States and India," *The Diplomat,* September 11, 2018.

[15] For views on this position in the early 2010s, see U.S. Department of Defense, *Quadrennial Defense Review Report*, 2010 (Washington, DC: Department of Defense).

[16] Prashanth Parameswaran, *Strengthening ASEAN-India Relations in the 21st Century* (Arlington, VA: Project 2049 Institute, 2010), p. 5.

[17] Myra MacDonald, "Pakistan's China Syndrome," Reuters, September 28, 2011. See also Jamal Afridi and Jayshree Bajoria, "China-Pakistan Relations," *Council on Foreign Relations*, July 6, 2010; and Zia Khan, "Eastern Alliance: Pakistan Lobbying for Defence Pact with China," *The Express Tribune*, September 27, 2011.

partnership between India and the Association of Southeast Asian Nations (ASEAN). Thus, knowledge of the military capabilities of China and India is essential to understanding power dynamics in Asia.[18]

Despite its importance, there is little comprehensive comparative scholarship on regional power and LDC military modernization.[19]

1.3 Literature on Regional Power Military Industries

Existing scholarship on regional power and LDC military modernization can be categorized into four distinct theoretical approaches: (1) structural/dependency; (2) economic/development; (3) dominance/world system; and (4) historical/systemic.[20] Each of these approaches can complement the others and reveal key patterns or factors in defense planning.

First, the structuralist/dependency approach argues that LDCs are dependent upon the more industrialized and militarily sophisticated powers atop the international power hierarchy.[21]

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[18] Avery Goldstein, "China's Grand Strategy under Xi Jinping: Reassurance, Reform, and Resistance." *International Security*, Vol. 45, No. 1 (2020), pp. 164-201.

[19] A few notable exceptions include Mohan Malik, *China and India: Great Power Rivals* (Boulder, CO: FirstForumPress, 2011); Jonathan Holslag, *China and India: Prospects for Peace* (New York: Columbia University Press, 2009); Ashley J. Tellis, Travis Tanner, and Jessica Keough, ed., *Asia Responds to Its Rising Powers: China and India* (Seattle: National Bureau of Asian Research, 2011); and John W. Garver, *Protracted Contest: Sino-Indian Rivalry in the Twentieth Century* (Seattle, WA: University of Washington Press, 2001). China and India were considered part of the "third world" and not considered industrially developed in the Cold War era in the literature. This perspective has changed especially since the 2010s.

[20] For an excellent review of these approaches in the arms trade literature see Timothy D. Hoyt, *Military Industry and Regional Defense Policy: India, Iraq and Israel* (London: Routledge, 2006).

[21] See for instance Stephanie G. Neuman, "International Stratification and Third World Military Industries," *International Organization*, Vol. 38, No. 1 (Winter 1984); Michael Brzoska and Thomas Ohlson, eds., *Arms Production in the Third World* (London: Taylor and Francis for SIPRI, 1986); and Çağlar Kurç, Richard A. Bitzinger, Stephanie G. Neuman, eds., *Defence Industries in the 21st Century: A Comparative Analysis* (London: Routledge, 2020).

Such dependence makes LDCs not only vulnerable to embargoes but also prohibits the expansion of domestic military-industrial bases. This approach is often exemplified by a "ladder of production" which maps the process in which states gradually develop military industries through technology absorption and advanced manufacturing.[22]

Second, the economic/development approach examines the economic opportunity costs of developing military industries and the effects of their policies.[23] Proponents of extensive military expenditure argue that it has positive effects on the rest of the economy. Rather than being a drain (zero-sum) on economic development, military expenditure is viewed as complementary. Most applications of this approach, however, challenge this logic and point out that military-industrial programs are less efficient at generating growth. This is because most military projects are more capital intensive than labor intensive.[24]

Third, the dominance/world system approach extends the developed/developing stratification of national capabilities and broadens it.[25] This approach argues that major powers prefer LDC subordination and actively attempt to maintain the supplier-recipient hierarchy. The dominance approach also emphasizes the harmful effects of technology on LDCs as well as

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[22] Keith Krause, *Arms and the State: Patterns of Military Production and Trade* (New York: Cambridge University Press, 1995), p. 171.

[23] For more on this approach see Nicole Ball, *Security and Economy in the Third World* (Princeton, NJ: Princeton University Press, 1988); and United Nations, Department for Disarmament Affairs, *Economic and Social Consequences of the Arms Race and Military Expenditures* (New York: United Nations, 1983).

[24] Timothy D. Hoyt, in Michael E. Brown, ed., *Grave New World: Security Challenges in the 21st Century* (Washington, DC: Georgetown University Press, 2003), pp. 29-30.

[25] See for instance Asbjörn Eide, and Marek Thee, eds., *Problems of Contemporary Militarism* (London: Croom Helm, 1980); Mary Kaldor and Asbjörn Eide, *The World Military Order: The Impact of Military Technology on the Third World* (London: Macmillan, 1979); and Helena Tuomi and Raimo Värynen, *Militarization and Arms Production* (New York: St. Martin's, 1983).

technological dependency.[26] It argues that import-substitution policies are counterproductive and, in some cases, may accelerate dependency because of the exploitation of cheap labor.

Finally, the systemic/historical approach emphasizes comparison of the international arms market through different periods.[27] For instance, the interwar period is one of the most widely used to compare the dynamics of multipolar systems with unipolar or bipolar ones. Comparison across time and environments magnifies the hierarchy of producers and allows for the identification of the different 'tiers of production' that correlate with the diffusion of technology and information.[28] Within this approach, diffusion plays an important role. Some analysts argue that "[b]y distinguishing multiple tiers of production and focusing on the historical process of technological change and diffusion, systemic analysis more accurately describes the position of both LDC and lesser industrialized producers in the global system."[29]

The latter approach, however, has been neglected in regional power and LDC studies for several reasons. First, many LDC studies adopted normative arguments associated with the two superpowers.[30] Second, in the pursuit of policies of military autarky and self-reliance, many

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[26] Michael Raska, "Strategic Competition for Emerging Military Technologies: Comparative Paths and Patterns." *Prism: A Journal of the Center for Complex Operations*, Vol. 8, No. 3 (January 2020), pp. 64-81.

[27] For more on this approach see Robert E. Harkavy, *The Arms Trade and International Systems* (Cambridge, MA: Ballinger, 1975); Keith Krause, *Arms and the State: Patterns of Military Production and Trade* (Cambridge: Cambridge University Press, 1992); and Edward Laurance, *The International Arms Trade* (Lexington, MA: Lexington Books, 1992).

[28] Barry Buzan, *An Introduction to Strategic Studies: Military Technology and International Politics* (Basingstoke, UK: Macmillan, 1987).

[29] Hoyt, *Military Industry and Regional Defense Policy*, p. 14.

[30] International arms transfers were often analyzed through a strictly political lens due to the Cold War. Initial studies of LDC arms industries focused on Cold War international arms trade, particularly the flow of arms from the US and Soviet Union to their allies. Here, many studies had a normative orientation and were critical of LDCs. Such normative positions argued that the production and acquisition of arms promoted militarist policies and anti-democratic movements in developing countries. Because such

LDCs resisted foreign dependence and alignment.[31] Third, many LDCs face more complex security threat environments than developed states.[32] Fourth, the end of the Cold War led to divergent patterns in the international arms market characterized by corporate consolidation and globalization.[33] On this latter point, some studies have argued that globalization decreases the risk of conflict and in actually makes stability more likely since military autarky becomes more difficult to achieve.[34] There are a few problems with this argument. The implications of the globalization of production and information in general may be different. States, especially great powers and rising powers, highly value independence and seek to minimize foreign dependence. This is highlighted by increasing competition over things like rare Earth metals and human capital and technological expertise.

To summarize, prior studies adequately covered foreign dependency, economic opportunity costs, and supplier-recipient relationships, but do not adequately analyze the security

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moralist and normative approaches dominated development studies as a whole, security-based approaches to LDC arms industries were frequently overlooked or under-utilized. See Michael T. Klare, "The Unnoticed Arms Trade: Exports of Conventional Arms-Making Technology," *International Security*, Vol. 8, No. 2 (Fall 1983), pp. 68-90.

[31] Beginning in the early 1960s many LDCs began to pursue strategies of import-substitution, diversifying suppliers, or indigenous production of arms. This shift was driven by fears of dependency and coercive tactics of the US and Soviet Union. After World War II only a handful of states were capable of designing and manufacturing military weapons but by the mid-1980s over 50 LDCs were arms producers with about a dozen considered to be major arms producers. See Michael Brzoska and Thomas Ohlson, "Arms Production in the Third World: An Overview," in Michael Brzoska and Thomas Ohlson, eds., *Arms Production in the Third World* (London: Taylor & Francis for SIPRI, 1986), pp. 16-17.

[32] This is due to competing internal and external threats. LDCs are more likely to be located in less-stable regions of the world. These security requirements also compete with domestic and international pressure to modernize.

[33] Hundreds of arms producing companies went into bankruptcy, liquidated, or merged resulting in a major decline in total arms transfers. This contraction in the number of arms producing companies was paralleled by a decline in research in the international arms trade.

[34] Stephen G. Brooks, *Producing Security: Multinational Corporations, Globalization, and the Changing Calculus of Conflict* (Princeton, N.J.: Princeton University Press, 2005); pp. 1-15 and 80-128.

requirements of regional powers. Some scholarship has demonstrated that changes in the security threat environment can compel states to intensify military modernization or encourage innovative strategies and capabilities.[35] Yet, this variable has not been linked with other variables to examine military modernization. This study builds on prior studies of arms industries in regional powers and LDCs by incorporating analysis of the security threat environment, and by more carefully defining and operationalizing the main variables responsible for military modernization.

1.3.1 *China and Military Modernization*

Since the late-1990s, China has become a greater concern for scholars and policymakers alike, resulting in an increased amount of substantive scholarship on its security and military policies. In 2000, Congress established the U.S.-China Economic and Security Review Commission to monitor and report on developments in the People's Republic of China (PRC). This coincided with a Congressional mandate directing the Department of Defense to annually report on China's military-technological development. Scholars and independent observers have followed these activities to produce a wide range of research. Collectively, these studies either specialize on key issues or generalize over a handful of recently produced MWS. For example,

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[35] Hoyt, *Military Industry and Regional Defense Policy: India, Iraq and Israel*; Robert E. Harkavy, *The Arms Trade and International Systems* (Cambridge, MA: Ballinger, 1975); Keith Krause, *Arms and the State: Patterns of Military Production and Trade* (Cambridge: Cambridge University Press, 1992); Barry R. Posen, *The Sources of Military Doctrine: France, Britain, and Germany Between the World Wars* (Ithaca, NY: Cornell University Press, 1984); and Williamson Murray and Allan R. Millett, *Military Innovation in the Interwar Period* (New York: Cambridge University Press, 1996). Some studies have looked at multiple factors behind military modernization in Asian countries, such as economic capability, the demand for a stronger military against a rising China, and access to technology related to the revolution in military affairs. See Ashley Tellis and Michael Wills, eds., *Strategic Asia 2005–06*: *Military Modernization in an Era of Uncertainty* (Seattle, WA: The National Bureau of Asian Research, 2005), pp. 3-40.

many studies concentrate on issues of force modernization,[36] revolution in military affairs (RMA),[37] and reform of the military industrial complex (MIC).[38] To date, very few authoritative studies have explored China's approach to RMA over a long period of time, and few such studies compare China's approach with India's.[39] Similarly, edited volumes provide a wide-range of themes but lack a cohesive assessment on conventional military modernization.[40] Many of these studies describe capabilities but do not examine what influences military modernization and its inputs.[41] Furthermore, China is featured less throughout the LDC/arms transfer literature—despite being a top arms exporter—because it primarily supplied small arms instead of MWS

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[36] Bates Gill, *Chinese Arms Transfers: Purposes, Patterns, and Prospects in the New World Order* (Westport, CT: Praeger Publishers, 1992); and John Wilson Lewis and Xue Litai, *China's Strategic Seapower: The Politics of Force Modernization in the Nuclear Age* (Stanford, CA: Stanford University Press, 1994).

[37] Bates Gill and Lonnie Henley, *China and the Revolution in Military Affairs* (Carlisle, PA: Strategic Studies Institute, 1996).

[38] Evan S. Medeiros, Roger Cliff, Keith Crane, James C. Mulvenon, *A New Direction for China's Defense Industry* (Arlington, VA: RAND Corporation, 2009).

[39] Notable examples include David Shambaugh, *Modernizing China's Military: Progress, Problems, and Prospects* (Berkely, CA: University of California Press, 2002); Richard D. Fisher Jr., *China's Military Modernization: Building for Regional and Global Reach* (Stanford, CA: Stanford University Press, 2010); Tai Ming Cheung, *Fortifying China: The Struggle to Build a Modern Defense Economy* (Ithaca, NY: Cornell University Press, 2008); and M. Taylor Fravel, *Active Defense: China's Military Strategy since 1949*, (Princeton University Press, 2019).

[40] Paul H.B. Godwin, ed., *The Chinese Defense Establishment: Continuity and Change in the 1980s* (Boulder, CO: Westview Press, 1983); Larry M. Wortzel, ed., *China's Military Modernization: International Implications* (New York: Greenwood Press, 1988); and Bates Gill, *Rising Star: China's New Security Diplomacy* (Washington, DC: Brookings Institution Press, 2007).

[41] See for instance Mark Weisenbloom and Dimon Liu, eds., *Chinese Military Modernization* (London: Kegan Paul International, 1996); Alexandre Sheldon-Duplaix, "Transformation of the Chinese Military," *Indian Defence Review* Vol. 21, No. 1 (Jan-March 2006); and Michael D. Swaine and Ashley J. Tellis, *Interpreting China's Grand Strategy: Past, Present, and Future* (Santa Monica, CA: RAND Corporation, 2000).

during the Cold War.[42] Thus, contemporary Chinese military studies neglect broad analysis of the underlying causes of military modernization.

Other studies discuss aspects of China's underperforming MIC. In the 2000s and early 2010s, there was a prevailing view that the People's Liberation Army (PLA) remained relatively "hollow" and dependent upon numerical advantages. This view is attributed to China's inability to acquire and integrate Western technology. According to some observers, when factors beyond weapon systems are considered, including professionalism in the officer corps, training and logistics, and morale, the PLA may be in worse shape than the US military was following the Vietnam War; however, this view may be changing.[43] China's aggressive pursuit of Western technology has closed many gaps. For example, China appears to have exploited stealth technology from the US F-35 Joint Strike Fighter program in its own J-20 and J-31 programs.[44] Additionally, China is expanding its power projection capabilities and its strategic and conventional missile capabilities. Likewise, the PLA Navy's expansion and upgrades has made it the world's largest naval fleet, though the quality of many of these systems may be less than that of US Navy systems. Despite mention of the above trends in China's military modernization, studies neglect many of the key policy decisions made during the 1980s and early 1990s that set the foundation for China's modernization.

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[42] A notable exception is Erik Baark, "Military Technology and Absorptive Capacity in China and India: Implications for Modernization," in Eric Arnett ed., *Military Capacity and the Risk of War: China, India, Pakistan and Iran* (London: Oxford University Press, 1997), pp. 84-109.

[43] Bates Gill and Michael O'Hanlon, "China's Hollow Military," in Scott Kennedy, ed., *China Cross Talk: The American Debate over China Policy since Normalization* (Lanham, MD: Rowman and Littlefield, 2003), pp. 202-208.

[44] Ellen Nakashima, "Confidential report lists U.S. weapons system designs compromised by Chinese cyberspies," *The Washington Post,* May 27, 2013.

International events have also had a significant impact on China. Observers argue that the Persian Gulf War was a defining moment for the PLA because of how effortlessly the US dismantled Iraq's military.[45] The PRC's Central Military Commission pays close attention to the global balance of power.[46] Some reports suggest that China predicted the collapse of the Soviet Union. This would explain one reason why China began reorganizing its indigenous defense industry throughout the late 1980s.[47] The collapse of the Soviet Union coupled with the 1989 Tiananmen Square massacre created an enormous geopolitical challenge for the PRC. Nevertheless, while the massacre brought arms embargoes from the West, the fall of the Iron Curtain provided the PLA quick access to surplus Soviet arms. Together, the arms embargoes and Gulf War made gaining access to Western technology a top priority and likely instigated widespread industrial espionage to obtain it.[48]

Further examples of studies on China note that its military modernization may look different due to contrasts in strategic culture and that China's defense industry faces the same problems as many other states.[49] These problems include reduction in demand, industry

[45] See David Shambaugh, *Modernizing China's Military: Progress, Problems, and Prospects* (Berkely, CA: University of California Press, 2002).

[46] James C. Mulvenon, Murray Scot Tanner, Michael S. Chase, David R. Frelinger, David C. Gompert, Martin C. Libicki, and Kevin L. Pollpeter, *Chinese Responses to U.S. Military Transformation and Implications for the Department of Defense* (Santa Monica, CA: RAND Corporation, 2006).

[47] Paul H. B. Godwin, "Force Protection and China's National Military Strategy," in C. Dennison Lane, Mark Weisenbloom, and Dimon Liu, eds., *Chinese Military Modernization* (London: Kegan Paul International, 1996), pp. 70-71.

[48] This is frequently documented in the US-China Economic and Security Review Commission's and Department of Defense's annual reports to Congress.

[49] Jacqueline A. Newmyer, "The Revolution in Military Affairs with Chinese Characteristics," *Journal of Strategic Studies,* Vol. 33, No. 4 (2010), p. 485.

consolidation, and rationalization of fiscal resources.[50] Several studies attempt to examine such conversion of defense spending into capabilities with mixed results.[51]

To summarize, a wide variety of scholarship on China's military forces exists; however, these studies do not adequately examine the factors influencing China's military modernization or effectively capture the evolution of its indigenous modernization capabilities.

1.3.2 *India and Military Modernization*

Existing scholarship on military modernization in India is less robust than that on China but it has an existing legacy within the regional power and LDC subfield. During the Cold War, research on India was prominent due to its role in international arms transfers.[52] Unlike China, there is no Congressional commission or Pentagon report focused on India, largely because US-India relations are less contentious than those with China. Prior scholarship on Indian military modernization concentrated on the Pakistani rivalry and failed defense planning.[53] Specifically, Indian military modernization for many decades has been constrained by a localized security

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[50] Bates Gill and John Frankenstein, "Current and Future Challenges Facing Chinese Defence Industries," *China Quarterly*, No. 146 (June 1996), p. 420.

[51] See for example Keith Crane et. al., *Modernizing China's Military: Opportunities and Constraints* (Washington, D.C.: RAND Corporation, 2005). RAND estimations are particularly significant since they often form the baselines for the Department of Defense.

[52] See for example Raju G.C. Thomas, "Defense Planning in India," in Stephanie G. Neuman ed., *Defense Planning in Less-Industrialized States* (Lexington, MA: Lexington Books, 1984).

[53] Raju G.C. Thomas, *Indian Security Policy* (Princeton, N.J.: Princeton University Press, 1986); and Chris Smith, *India's Ad Hoc Arsenal: Direction or Drift in Defence Policy?* (New York: Oxford University Press for SIPRI, 1994).

threat environment dominated by Pakistan, foreign military technology dependence, and maligned defense planning.[54]

On the security threat environment, while China influenced some of India's military modernization just after the 1962 war, the proximate threat of Pakistan shaped much of India's military modernization and defense planning.[55] In the mid-1970s, India became more aggressive in its national security following three wars between 1962 and 1971.[56] The wars revealed vulnerabilities and shifted India's security posture from a policy of self-sufficiency to one of self-reliance. Emphasis on Pakistan meant that defense planning favored the Army over the Air Force and Navy.[57] Focus on Pakistan intensified after both sides developed and tested nuclear weapons in the late 1990s, at which point, strategic nuclear capabilities became the driving force in defense planning, further weakening investment in naval and aerial capabilities. India's focus during and since the 2010s has been shifting towards China's rise and its strategic implications.[58]

On foreign military technology dependence, India has struggled to reverse its dependence through a policy of defense autarky. Defense planners had to balance competing demands for short-term qualitative military superiority, which required extensive foreign imports, and long-

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[54] Ashley J. Tellis, "India: Capable but Constrained," in Gary J. Schmitt, ed., *A Hard Look at Hard Power: Assessing the Defense Capabilities of Key US Allies and Security Partners—Second Edition* (Carlisle, PA: US Army War College Press, 2020).

[55] Hoyt, *Military Industry and Regional Defense Policy: India, Iraq, and Israel*, p. 5.

[56] These conflicts include the 1962 Sino-Indian War, the 1965 Indo-Pakistani War, and the 1971 Indo-Pakistani War.

[57] Jaswant Singh, *Defending India* (New York, N.Y.: St. Martin's Press, 1999), pp. 127-138.

[58] Yogesh Joshi and Anit Mukherjee, "Offensive Defense: India's Strategic Responses to the Rise of China," in Kanti Bajpai, Selina Ho, Manjari Chatterjee Miller, eds., *Routledge Handbook of China-India Relations* (London: Routledge, 2020).

term military self-sufficiency.[59] The prior conflicts taught Indian policy-makers that the nation could not rely on quantitative advantages or risk dependency on foreign suppliers for critical armaments. This resulted in fewer arms imports from Great Britain and more from the Soviet Union, which was viewed as a more reliable supplier.

Several reasons are attributed to India's inability to reverse foreign military dependency.[60] First, the nature of the international arms industry is fundamentally small, risk-averse, and difficult to enter.[61] Following the collapse of the Soviet Union, arms transfers declined and the industry consolidated, with much of it concentrated in the US.[62] This declination and consolidation poses challenges for rising states like China and India because they lack developed economies of scale across the MIC.[63] Second, acquisition policy is flawed because Indian politicians prefer indigenous MWS because they guarantee constituent contracts and jobs, and further reinforce self-reliance. As a result, the Ministry of Defense disproportionately proposes MWS that are more likely to be approved by politicians.[64] Third, India's arms procurement process is subject to the competing interests and influence of three

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[59] Amit Gupta, *Building an Arsenal: The Evolution of Regional Power Force Structures* (Westport, CT: Praeger Publishers, 1997).

[60] Deba R. Mohanty, "Changing Times? India's Defence Industry in the 21st Century," Bonn International Center for Conversion, June 2004, pp. 4-6.

[61] Ravinder Pal Singh, ed., *Arms Procurement Decision Making Volume I: China, India, Israel, Japan, South Korea and Thailand* (New York: Oxford University Press for SIPRI, 1998).

[62] Stephanie G. Neuman, "Power, Influence, and Hierarchy: Defense Industries in a Unipolar World," *Defence and Peace Economics*, Vol. 21, No. 1 (February 2010), pp. 105-134.

[63] Ibid, p. 133.

[64] Raju G.C. Thomas, "The Armed Services and the Indian Defense Budget," *Asian Survey*, Vol. 20, No. 3 (March 1980), pp. 280-297.

groups: the military, civil bureaucrats and politicians, and economists.[65] These three groups openly compete for influence in national security matters, leading to conflicting defense procurement priorities.

In regards to India's defense planning and reform, studies characterize India as constantly "fighting change."[66] This is because of its inability to implement widescale reforms and a consistent national security strategy. Chief among the inhibiting factors is the organization of the armed forces, notably the Army and MIC, which dictate acquisition policy and research and development. For most of its history, India has been on the wrong side of military acquisition problems due to competing requirements and bureaucratic infighting.[67] As a result, India has been forced to pursue sporadic bulk arms transfers as stopgaps to avoid block obsolescence.

Furthermore, India's complex culture may pose unique social and organizational challenges to reform and development.[68] This competition has resulted in three distinct defense policy preferences. The military's primary objective is to achieve parity in capabilities with potential adversaries. Politicians, on the other hand, overwhelmingly prefer to assert independence in defense policy via technological self-reliance. Finally, economists prefer to find a balance between the cost and quality of arms, which is typically best achieved through licensed production of foreign weapons. Because of these preferences, India's weapons procurement

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[65] Thomas, *Indian Security Policy*, pp. 246-247.

[66] Stephen P. Cohen and Sunil Dasgupta, *Arming without Aiming: India's Military Modernization* (Washington, D.C.: Brookings Institution Press, 2010).

[67] Ibid, p. 30-36.

[68] Stephen P. Rosen, *Societies and Military Power: India and its Armies* (Ithaca, N.Y.: Cornell University Press, 1996); see also Theo Farrell and Terry Terriff, eds., *The Sources of Military Change: Culture, Politics, and Technology* (New York: Lynne Reinner Publications, 2001); and Dima Adamsky, *The Culture of Military Innovation: The Impact of Cultural Factors on the Revolution in Military Affairs in Russia, the US, and Israel* (Redwood City, CA: Stanford University Press, 2010).

policies can be categorized and examined in terms of importation, indigenous production, and licensed production.

Thus, existing studies on India are limited and only emphasize a handful of issues such as the Pakistani security threat, foreign technology dependence, and maligned defense planning practices. This study aims to fill some of these gaps and better examine the factors influencing military modernization in India.

To summarize, this dissertation bridges prior regional power and LDC approaches with contemporary security research to examine military modernization in China and India. Next, this study identifies how alternative explanations and approaches related to military modernization contrast and/or complement those within regional power and LDC scholarship. The discussion below emphasizes the argument that contemporary approaches to studying military modernization are inadequate for studying China and India.

1.4 Alternative Explanations- Innovation, Economics, and Bureaucratic Politics

Existing studies on military modernization fall into three general categories: military innovation/diffusion, defense economics, and bureaucratic politics. These studies can be helpful in explaining why states make progress or stagnate in military modernization but are collectively inadequate in overlooking salient issues relevant to regional powers and military modernization.

Military innovation studies are prominent for their focus on major innovations in military technology or capabilities that have tilted the balance of war in many conflicts.[69] The key

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[69] Barry R. Posen, *The Sources of Military Doctrine: France, Britain, and Germany Between the World Wars* (Ithaca, N.Y.: Cornell University Press, 1984); Allan R. Millett, "Patterns of Military Innovation," in Williamson Murray and Allan R. Millett, eds., *Military Innovation in the Interwar Period* (New York, N.Y.: Cambridge University Press, 1996), pp. 349-367; Stephen P. Rosen, *Innovation and the Modern Military: Winning the Next War* (Ithaca, N.Y.: Cornell University Press, 1991), pp. 19-22.

questions in most of these studies are what prompts innovation and what determines their diffusion.[70] Past innovations include aircraft carriers, radar, blitzkrieg, and nuclear weapons. These examples, however, are limited to very few states at particular moments in time. Military innovations are rare despite states continuously working towards modernizing their armed force. While useful, this approach promotes a narrow view of modernization by analyzing select capabilities rather than whole force structures. Historically, military innovations represent flashpoints or signposts in the broader trend of military modernization.[71] Focusing on them alone produces an incomplete measure of military power that is not always indicative of victory in war.[72] Military innovation studies are further biased towards great powers and omit innovation in regional powers and LDCs. Finally, their application is not effective in examining international conflicts dominated by regional powers with less than state-of-the-art capabilities.

In regards to defense economics, many scholars associate increased military expenditure and arms procurement with increases in total economic output (GDP), and vice versa.[73] Such

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[70] Michael C. Horowitz, *The Diffusion of Military Power: Causes and Consequences for International Politics* (Princeton, N.J.: Princeton University Press, 201); Emily Goldman and Richard Andres, "Systemic Effects of Military Innovation and Diffusion," *Security Studies,* Vol. 8, No. 4 (Summer 1999); Emily O. Goldman and Leslie C. Eliason, eds., *The Diffusion of Military Technology and Ideas* (Stanford, CA: Stanford University Press, 2003).

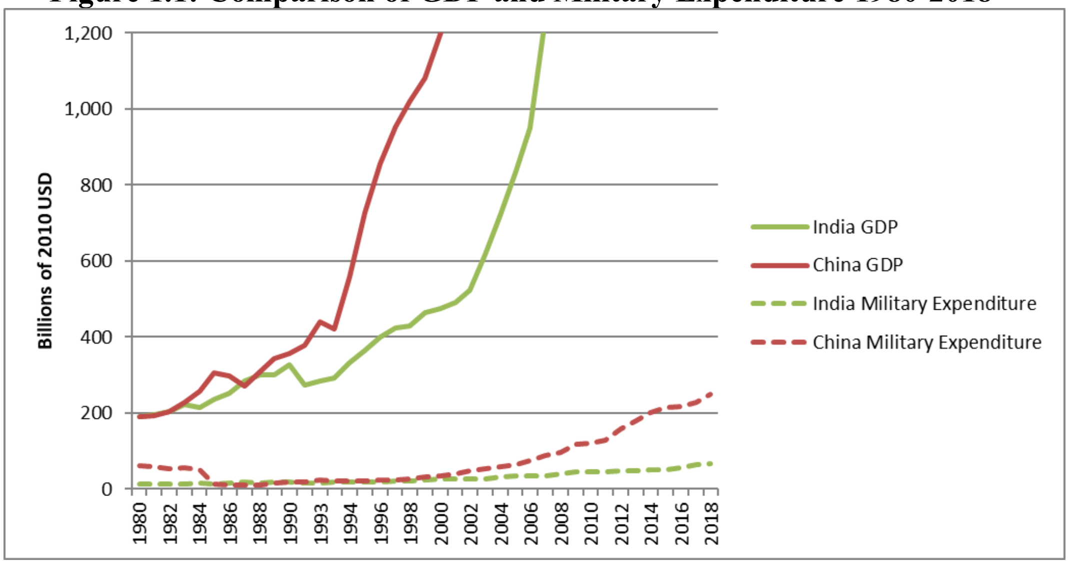
[71] In the case of the interwar period the environment and development of MMIs do not necessarily translate across time, geography, and/or culture. See for example: Peter Gran, *Beyond Eurocentrism: A New View of Modern World History* (Syracuse, N.Y.: Syracuse University Press, 1996); Steve Smith, "The Discipline of International Relations: Still an American Social Science?" *The British Journal of Politics and International* Relations, Vol. 2, No. 3 (2000); and Immanuel Wallerstein, "Eurocentrism and its Avatars: the Dilemmas of Social Science," keynote address at ISA East Asian Regional Colloquium 'The Future of Sociology in East Asia' (Nov. 22-23, 1996, Seoul, Korea).

[72] See Stephen Biddle, *Military Power: Explaining Victory and Defeat in Modern Battle* (Princeton, NJ: Princeton University Press, 2006); and Williamson Murray and Allan R. Millett, eds., *Military Innovation in the Interwar Period* (New York, N.Y.: Cambridge University Press, 1996).

[73] Andrew L. Ross, *The Political Economy of Defense: Issues and Perspectives* (Westport, CT; Greenwood Press, 1991); Nicole Ball, *Security and Economy in the Third World* (Princeton, NJ: Princeton University Press, 1988); David K. Whynes, *The Economics of Third World Military*

studies also analyze the economic impact of defense industrialization, challenging the assumption that militarization produces economic spinoff benefits. They commonly suggest a linear pattern between economics and military modernization; however, this expectation is not supported by recent data as demonstrated in Figure 1.1.

Figure 1.1: Comparison of GDP and Military Expenditure 1980-2018[74]



From the mid-1990s to late 2010s, economic growth was typically 6-10 percent annually in China and 4-8 percent in India. At the same time, their annual military expenditure grew by less than this percentage. Thus, economic arguments for examining military modernization, especially its scale and size, are incomplete.

Expenditure (London: MacMillan, 1979); James Everrett Katz, ed., *Arms Production in Developing Countries* (Lexington, MA: Lexington Books, 1984); Raju G.C. Thomas, *The Defence of India: A Budgetary Perspective of Strategy and Politics* (Delhi: MacMillan Company of India, 1978); Dan Smith and Ron Smith, *The Economics of Militarism* (London: Pluto Press, 1983); Keith Hartley, *The Economics of Defence Policy: A New Perspective* (New York: Routledge, 2010); and Richard A. Bitzinger, *The Modern Defense Industry: Political, Economic, and Technological Issues* (Santa Barbara, CA: Praeger, 2009).

[74] Data pulled from the World Bank's World Develop Indicators Database and the Stockholm International Peace Research Institute (SIPRI) Military Expenditure Database; accessed November 2020.

In terms of bureaucratic politics, sometimes described in organizational terms, scholars have argued that the combination of political actors and structural dynamics can be a strong prohibitor of effective military modernization.[75] This approach argues that institutions are "complex political communities" inherently averse to change except in light of failure, expansionist goals, and clientele pressure.[76] It is useful in understanding the internal political process of military modernization, particularly when examining the arms procurement process. Likewise, it is helpful in demonstrating the political balance of power within organizations such as large, fragmented organizations like defense where one service may dominate the others for influence and resources. Most importantly, this approach argues that organizations prefer the status quo and need "demonstration events" or other external stimuli to innovate or reform.[77]

Despite these benefits, bureaucratic politics is an insufficient approach to investigating military modernization over the long-term. First, this variable emphasizes the role of individuals and organizational structures rather than external factors. This omits several potentially influential variables, or at least minimizes them. Second, this approach focuses on the importance of the oft-overlooked political debates as opposed to focusing on economic and technological patterns.

In sum, these studies are important to understanding certain aspects of military modernization, but they are incomplete approaches for examining broader patterns, particularly

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[75] Theo Farrell, *Weapons without a Cause: The Politics of Weapons Acquisition in the United States* (New York: St. Martin's Press, 1997); Stephen P. Cohen and Sunil Dasgupta, *Arming Without Aiming: India's Military Modernization* (Washington, DC: Brookings Institution Press, 2010); and Ravinder Pal Singh, *Arms Procurement Decision Making: Volume 1: China, India, Israel, Japan, South Korea and Thailand* (London: Oxford University Press, 1999).

[76] Richard L. Kugler and Hans Binnendijk, "Choosing a Strategy," in Hans Binnendijk, ed., *Transforming the American Military*, (Washington, DC: National Defense University Press, 2002), p. 72.

[77] Andrew Krepinevich, "Cavalry to Computer: The Pattern of Military Revolutions," *National Interest,* No. 37 (Fall 1994), p. 40.

in the cases of China and India. This study utilizes four variables that complement military innovation, defense economics, and bureaucratic politics in order to provide a fuller explanation for China's and India's military modernization. Likewise, it shows how the variables change over time and how those changes sometimes influence each other causing significant shifts in military modernization decisions.

1.5 Summary and Structure of the Dissertation

Since the 1980s, China and India have extensively modernized their armed forces. Existing literatures on regional powers and LDC military modernization, on China and India's militaries, and on bureaucratic and economic explanations for military modernization are inadequate in examining each country's military modernization. Illustrating this, military modernization in China and India do not exclusively correlate with levels of higher economic growth, contrary to expectations from the economic explanations for modernization. Thus, military modernization is not highest in the periods of highest economic growth, and vice versa. This study accounts for this variation by introducing four additional variables. It demonstrates that military modernization is highest during periods where most of the independent variables are high and lowest when the independent variables are low. It further shows that the significance of each variable, at times, changes from period to period due to internal and external changes in the political and security environment. For instance, China's leaders made the strategic determination in the early 1980s that it could forgo military modernization in exchange for reform and investment in its economy. That calculation changed, however, in the 1990s in light of the RMA and emerging political conflicts over Taiwan. Likewise, the availability of foreign arms suppliers has profound impact on military industrial capacity. China's lack of arms suppliers almost certainly made military industrial capacity not just an issue of status, but also a national security imperative. This imperative likely drove alternative means of development and procurement to include coerced technology transfer and systemic industrial espionage.

The remainder of this dissertation is organized as follows. Chapter 2 provides the theoretical and methodological framework for this study. Chapter 3 analyzes military modernization in India and assesses the impact of the four independent variables through eight time periods. Chapter 4 analyzes military modernization in China and assesses the impact of the four independent variables through the same eight time periods. The final chapter compares and contrasts the cases and elaborates on the key conclusions. This includes the argument that changes in the security threat environment as determined by regional instability and changes in opponent capabilities have a more significant impact than changes in the other variables. In particular, major demonstration events and armed standoffs influence political leaders and defense planners in ways that other variables do not. Second, China has been more aggressive and effective than India at improving its military industrial capacity through a wider set of approaches, both legal and illegal.

Chapter II

Methodology: Case Selection and Variables Influencing Military Modernization

This chapter discusses the primary methodological issues in this study. It begins by discussing the comparative case study approach to examining China's and India's military modernization, and the selection of these cases. It then examines how four variables influence military modernization in China and India: military industrial capacity, available foreign suppliers, military obsolescence, and the security threat environment.

2.1 Comparative Case Study Method

The structured and focused comparative case study method is a valuable way of examining China's and India's military modernization for four reasons. First, studies based exclusively on quantitative data offer a large number of observations (such as arms data for several decades), but do not assess how multiple factors interact and contribute to particular episodes in military modernization, particularly in China and India. In contrast, a historical qualitative case study allows for better understanding of significant episodes in military modernization by examining the details of influential variables and their interaction. Second, while the case study method may focus on just a small number of cases, the 'small-n' problem can be overcome by expanding the number of observations within cases.[1] This is done by identifying and distinguishing unique observations of modernization at different time-periods within the cases themselves, thus greatly increasing the number of observations. Third, the case study method allows the use of process-tracing, where each variable is examined over a long

[1] Gary King, Robert O. Keohane, and Sidney Verba, *Designing Social Inquiry: Scientific Inference in Qualitative Research* (Princeton, N.J.: Princeton University Press, 1994), p. 52.

time period in each case, as an integral component of inquiry rather than a supplementary one.[2] Fourth, process-tracing does more than just increase the number of observations. An unexpected piece of evidence discovered during the process adds to historical knowledge of the case and allows for new historical interpretations and new insights into the significance of the case.[3]

Examining military modernization in two cases (China and India) over 40 years mitigates some of the unique methodological problems associated with studying military modernization in general. Military modernization is a process that occurs over an extended period of time. As a result, small snapshots that focus on one period of time or one major weapon system (MWS) cannot accurately portray a state's modernization program. Likewise, descriptive studies may examine and describe the modernization of some weapon systems, but they do not provide an integrated multi-variable explanation for such modernization.

In this dissertation, each case study is divided into eight periods based on approximately five-year intervals beginning in 1980 (excluding the final period). Breaking down each case into these eight periods enables the magnification of key developments and identification of significant patterns. Each period begins with a brief background of events and political developments. The background is followed by a description of developments in the dependent variable during that period. This description is primarily composed of an analysis of key MWS procured from abroad or produced indigenously. Finally, each period concludes with an analysis of the independent variables and their impact on military modernization.

[2] Alexander L. George and Andrew Bennett, *Case Studies and Theory Development in the Social Science* (Cambridge, MA: MIT Press, 2005), pp. 207-211.

[3] Ibid, p. 13.

2.2 Selection of the Cases

The case study selection is based on several points. First, China and India have been two of the most active states engaged in military modernization in the late twentieth and early twenty-first centuries. They have each created large military industrial complexes (MIC) capable of servicing a wide range of MWS. Furthermore, their history of conflict makes their relationship an enduring rivalry.[4] This rivalry will have considerable geo-political influence for the foreseeable future.

Second, both states shared somewhat similar and comparable socio-economic characteristics in 1980, including low industrialization and large under-educated populations, making it a unique starting point. Both states also faced similar constraints to military industrialization that were not present in major arms-producing Western states and the Soviet Union.

Third, their contrasting models of domestic governance and economic development allow for better comparative insights. China, the world's most populous nation, maintains a highly centralized and authoritarian political regime centered on the Chinese Communist Party (CCP) and modern China represents one of the fastest and largest cases of industrialization in history. In contrast, India is the world's largest democracy with one of the most diverse populations, but its economic growth and development has not been as profound as China's. Also, India continues to struggle with its colonial history and find its identity in the international community. These distinctions are important in assessing the relative influence of political structures and processes and how they interact with the independent variables in the formation of military-industrial policy.

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[4] John W. Garver, *Protracted Contest: Sino-Indian Rivalry in the Twentieth Century* (Seattle, WA: University of Washington Press, 2002).

Fourth, China and India possess similarities in contemporary histories and strategic dilemmas. Each state has dealt with its own set of limitations including military defeat, international sanctions, and aggressive neighbors. They each face a combination of internal and external threats and have historically been a land power relegated to the Asian mainland. They each possess mostly minimum nuclear deterrents. Each state possesses a different resource endowment and a distinct set of external circumstances.

To summarize, examination of China and India is important because they are comparatively under-studied, major military modernizers, politically and culturally dissimilar, and face dynamic regional security challenges.

2.3 Dependent Variable: Military Modernization

Military modernization is defined as the "relevant upgrade or improvement of existing military capabilities through the acquisition of new imported or indigenously developed weapons systems."[5] In looking at military modernization, this study focuses on conventional MWS, including their type, value, quantity, and origin.[6] MWS are best described as completed platforms, or a 'system of systems,' including armored tanks, jet fighter aircraft, bomber aircraft, submarines, destroyers, and aircraft carriers, that comprise the bulk of the heavy military hardware in a country's armed forces.[7] This study excludes strategic nuclear weapons delivery systems, ballistic missiles, tactical missiles, and most unarmed support platforms. Nuclear and

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[5] Ashley J. Tellis and Michael Wills, eds., *Strategic Asia 2005-06: Military Modernization in an Era of Uncertainty* (Seattle, WA: The National Bureau of Asian Research, 2006), p. 15.

[6] Edward Luttwak and Stuart L. Koehl, *The Dictionary of Modern War* (New York, N.Y.: Gramercy Publishing, 1998), p. 661.

[7] For the purpose of brevity and convenience missiles, armored personnel carriers, artillery, unmanned aerial vehicles, and space systems are not included in this classification.

ballistic missile capabilities are excluded from this study because in most relevant cases, states disproportionality invest in these programs, and they are not reliable indicators of military modernization or military power overall. China and India became nuclear powers in 1964 and 1974, respectively, but neither were considered to possess modern militaries with state-of-the-art capabilities at the time. The same can be said of Iran, North Korea, and Pakistan which have pursued and/or possess nuclear capabilities, but not modernized militaries capable of extended power-projection. This distinction is important because great powers are defined by their ability to project power beyond their borders, which is most commonly exercised by conventional military capabilities—by land, air, and sea.[8] Likewise, nuclear weapons are treated with the upmost security, making in-depth analysis of their programs difficult as well as an inadequate measure of state-wide military industrial capacity and latent power. However, select strategic systems are included in this study due to their capacity to support and deliver conventional weapons, including ballistic missile submarines and bomber aircraft.[9]

Outside of military expenditure, MWS is the most common measure of military modernization.[10] They are unique from small arms and less-significant weapons platforms in three ways. First, they are complex and require sophisticated technology and processes to manufacture. Second, because of their complexity and higher cost, MWS are more exclusive. Third, they require high levels of maintenance, infrastructure, and training to operate. As a result,

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[8] John J. Mearsheimer, *The Tragedy of Great Power Politics* (New York, N.Y.: W.W. Norton & Company, Inc., 2001), pp. 83-137.

[9] In particular, this study includes China's Type-094 and India's Arihant class ballistic missile submarines, as well as China's H-6 bomber aircraft.

[10] George J. Gilboy and Eric Heginbotham, *Chinese and Indian Strategic Behavior: Growing Power and Alarm* (New York: Cambridge University Press, 2012), pp. 164-208.

analysis of MWS produces a more robust understanding of a state's capabilities and techno-industrial potential.[11]

To examine MWS, a wide range of data associated with each MWS is collected and organized into a database, including type, conception date, prototype, certification, production, quantities, unit cost, origin, and variants. Only weapons ordered or produced between 1980 and 2018 are studied, including 'legacy' systems that have been in production for extended time. The majority of this data is drawn from the Stockholm International Peace Research Institute's (SIPRI) Arms Transfers Database and the International Institute for Strategic Studies' *The Military Balance*. The remainder of the data is pulled from a variety of open sources.

To provide a snapshot of total estimated military modernization per period, the 'Projected Estimated Value' of each system is calculated in given time periods. However, a methodological limitation is that the monetary figures for particular time periods may either undercount or exceed the actual expenditures. This is because weapon systems are often procured and financed over several years or a decade, spanning two to three time periods in this study. In such cases, the entire procurement is counted in the first relevant time period, or portions of the procurement are counted separately in two or three time periods. Also, the snapshot is not comprehensive, as some weapon systems are not included in tables for particular time periods though they may be mentioned in the discussion of that time period or other time periods. Additionally, the Projected Estimated Value serves to provide an estimate of military modernization, not total military expenditure which may be substantially more. However, insufficient military expenditure often limits military modernization, particularly in the case of India.

[11] Reliance on MWS as a unit of measure does possess some limitations for the purpose of measuring industrial capability; however, for more see Timothy D. Hoyt, "Technology and Security," in Michael E. Brown, ed., *Grave New World: Security Challenges in the 21st Century* (Washington, DC: Georgetown University Press, 2003), pp. 19-21.

In most cases, data for the Projected Estimated Value are collected from the SIPRI Military Expenditure Database and the SIPRI Yearbook. For figures not readily available from SIPRI, or where conversions from local currency are necessary, the study employs the International Monetary Fund's annual average of market exchange rates as provided in *International Financial Statistics*.[12] The US Bureau of Labor and Statistics' Consumer Price Index (CPI) Inflation Calculator is used for conversion into 2010 constant dollars. Despite some limitations, "[c]onstant prices allow meaningful comparisons of the resources consumed by the military over time, allowing for inflation, while conversion to a common currency allows some measure of cross-country comparison."[13]

A summary of the major weapons systems analyzed in this study is shown in Table 2.1. Overall, China's military modernization has been larger than India's, and is especially large for the PLA navy, which—excluding aircraft carriers—has more than doubled compared to the Indian navy.

Table 2.1: Approximate MWS Procurement, 1980s to mid-2010s

	Type of System and Approximate Number in each country
Army Modernization	Tanks (few thousand), Helicopters (hundreds, combining Army and Air Force)
Navy Modernization	Aircraft Carriers (2-3), Destroyers (tens), Frigates and Corvettes (several tens), Submarines (tens)
Air Force Modernization	Fighters, Fighter-Ground Attack, and Bombers[14] (several hundred to over one thousand), Transport aircraft (tens), Refueling tankers (about ten)

[12] There is dispute as to whether market exchange rates are more effective than purchasing power parity (PPP) rates, but in terms of military expenditure, PPP is considered to be less reliable. For more see "Monitoring Military Expenditure," Stockholm International Peace Research Institute (SIPRI), accessed January 2021.

[13] Ibid.

[14] After the retirement of its Canberras in the early 1990s, India ceased operating dedicated bombers. IISS classifies the majority of India's combat aircraft as Fighter Ground Attack (FGA). China, however, still operates the H-6 dedicated heavy bomber.

Based on the Projected Estimated Value of modernization, overall military modernization is then categorized as low (less than $10 billion), moderate ($10 billion to $20 billion), and high ($20 billion to $40 billion) or very high (greater than $40 billion) as seen in Table 2.2. below. These measurements are based on comparative distinctions of total military expenditure between the top military powers, major military powers, and the rest of the international community as determined by the median year of this study, 1999, to establish a baseline measure of comparison.[15] Excluding, China and India, only three states possessed military expenditure in excess of $40 billion (very high) in 1999 (in descending order: US, UK, and Japan).[16] Similarly, only three other states possessed military expenditure in excess of $20 billion (high) in 1999 (in descending order: France, Germany, and Italy). Only six other states registered military expenditure in excess of $10 billion (moderate) in 1999 (in descending order: Saudi Arabia, South Korea, Spain, Turkey, Taiwan, and Brazil).[17] While the Projected Estimated Value of military modernization is based upon the total for each period (five years for periods 1-7, and four years for period 8), measuring it against this standard is an effective means of tracking and categorizing military modernization over an extended time period.[18]

[15] Figures for establishing this baseline were derived from 1999 current USD prices, converted at the exchange rate for that given year as reported in the SIPRI Military Expenditure Database.

[16] China and India spent $20 billion and $14 billion, respectively, on military expenditure in 1999.

[17] Brazil, Taiwan, and Turkey each round approximately to $10 billion in 1999.

[18] There is also an assumption that states should invest approximately 20 percent of their military expenditure towards modernization; however, there is no scientific research to support this claim. But if applied, a state's military modernization should roughly equal one year's total defense budget every five years.

Table 2.2: Military Modernization Based on Projected Estimated Value								
	P1	P2	P3	P4	P5	P6	P7	P8
China	LOW	LOW	MODERATE	MODERATE	HIGH	HIGH	VERY HIGH	HIGH
India	MODERATE / NEAR HIGH	LOW	LOW	LOW	MODERATE / NEAR HIGH	HIGH	HIGH	HIGH

2.4 Independent Variables

The four independent variables in this study are military industrial capacity; the availability of foreign suppliers; military obsolescence; and the security threat environment. While not entirely exclusive from each other or representative of every factor considered in defense planning, these four variables influence pivotal patterns or changes in the intensity and nature of military modernization.

Military Industrial Capacity

Military industrial capacity is the means and ability to develop and produce MWS.[19] Higher military industrial capacity allows for more military modernization. In addition, the broader the military industrial capacity in a state, the broader the goals of military modernization a state may pursue. Lower levels of military industrial capacity will constrain arms procurement and lead to lower levels of military modernization. While several different indicators may be used to assess military industrial capacity, this study incorporates GDP, high-technology export rates, research and development (R&D), tertiary education enrollment, and major policy

[19] Existing studies commonly tie this variable to the ladder of production, which identifies the steps of military industrialization. See Richard A. Bitzinger, ed., *The Modern Defense Industry: Political, Economic, and Technological Issues* (Santa Barbara, CA: Praeger Security International, 2009), pp. 313-314.

changes.[20] Through an assessment of these indicators, military industrial capacity can be measured as high/moderate/low. These represent relative levels for each indicator per time period rather than absolute levels.

GDP and high-technology exports demonstrate total economic resources for capital-intensive military modernization. GDP provides a broad measure of national economic growth and base to draw defense expenditure, which is often designated as a proportion of GDP. High-technology exports represent a percentage of total manufactured export goods which the World Bank defines as "products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery."[21] This indicator is appropriate for assessing a state's national technology base and its ability to support increasing military industrial capacity. However, it does have limitations as the World Bank notes: "Because industrial sectors specializing in a few high-technology products may also produce low-technology products, the product approach is more appropriate for international trade. The method takes only R&D intensity into account, but other characteristics of high technology are also important, such as knowhow, scientific personnel, and technology embodied in patents." This study partially addresses these limitations by considering human capital, R&D, and select

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[20] In addition to R&D and tertiary enrollment, several other indicators have been used to measure techno-industrial output/capacity. These include academic and/or professional publication rates, science awards, patent rates, size of specialized labor force, and number of laboratories. See also Timothy D. Hoyt, *Military Industry and Regional Defense Policy: India, Iraq and Israel*; and Amit Gupta, *Building an Arsenal: The Evolution of Region al Power Force Structures* (Westport, CT: Praeger, 1997).

[21] The World Bank further defines this indicator as: "The OECD [Organisation for Economic Co-operation and Development] has developed a four-way classification of exports: high, medium-high, medium-low and low-technology. The classification is based on the importance of expenditures on research and development relative to the gross output and value added of different types of industries that produce goods for export. Examples of high-technology industries are aircraft, computers, and pharmaceuticals; medium-high-technology includes motor vehicles, electrical equipment and most chemicals; medium-low-technology includes rubber, plastics, basic metals and ship construction; low-technology industries include food processing, textiles, clothing and footwear." World Development Indicators, The World Bank, accessed June 2021.

indigenous MWS for export. Additionally, some reports point to China's position as a major *assembler* of high-technology products instead of the *developer* sponsoring R&D of such products.[22] Critics may point to common household electronics such as mobile phones, computers, and televisions as examples. This criticism is partially true but also needs more examination as it downplays the significance of co-opting and coercing foreign technology companies to transfer more than just the means of production. Furthermore, this criticism is inconsistent with China's exponential investments into R&D and the changing nature of its high-technology exports which are decreasingly composed of low- and middle-technology manufactured products.[23]

R&D investment has consistently been identified as a key component to both military industrial capacity but also overall national science and technology productivity.[24] [25] Nearly all indigenous MWS under development are funded through government military R&D appropriations, particularly in developing states which have low private R&D investment rates. These funds are managed by government military research institutes. In India, R&D is primarily managed by the Defence Research and Development Organization, and to a lesser extent the various Defence Public Sector Undertakings. In China, this task is handled by the General

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[22] Yuqing Xing, "China's High-Tech Exports: The Myth and Reality," *Asian Economic Papers,* Vol. 13, No. 1 (Winter 2014), pp. 109-123.

[23] Thomas Hout and Pankaj Ghemawat, "China vs the World: Whose Technology Is It?" *Harvard Business Review*, December 2010; and Yanfei Li, "Understanding China's Technological Rise," *The Diplomat*, August 3, 2018.

[24] On military R&D see Daniel S. Greenberg, *The Politics of Pure Science* (Chicago: University of Chicago Press, 1999); and David C. Mowery and Nathan Rosenberg, *Paths of Innovation: Technological Change in Twentieth-Century America* (Cambridge: Cambridge University Press, 1998).

[25] "India's Emerging Competitiveness as Destination of Global R&D" (New Delhi: Battelle India and Federation of Indian Chambers of Commerce and Industry, July 2013); and Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, *Report of the Defense Science Board Task Force on Basic Research* (Washington, DC: Defense Science Board, January 2012).

Armament Department and the State Council's State Administration for Science, Technology and Industry for National Defense. R&D data is collected from official government expenditure data and in some cases (China) credible secondary sources. This data is compared to Western arms producers that invest high amounts into R&D. For example, the US and UK devote on average 8-10 percent of their defense budgets towards R&D. Historically, only a handful of major powers spent more than $1 billion per year on R&D. Among the 36 OECD member states, only 7 spent beyond $1 billion in 2018, and nearly all remaining members spent below $500 million.[26] Thus, military R&D is primarily the prerogative of major powers and rising states. Data for each period is measured and classified as low/moderate/high depending on the relative R&D rates for that period.

Finally, systematic military industrial espionage may be considered a form of R&D that contributes directly toward military industrial capacity. Espionage serves a dual-purpose of intelligence gathering and pseudo-R&D, but it is not always clear when the former transcends to the latter. This issue is addressed in select case study periods and in detail in Chapter 5; however, there are some limitations to analyzing espionage. First, it is difficult to measure in both quantity and impact. States typically do not claim attribution which is particularly complicated in the cyber domain as states often conduct operations under false flag for intentional misattribution. It is also rarely clear what was precisely stolen as defense contractors have incentive to protect their intellectual property and disincentive to publicly admit their security vulnerabilities and loss of property. Second, it is not always clear whether espionage directly contributed to a state's new or improved capabilities. The case of the Soviet Union's espionage against the US Manhattan Project demonstrates the profound implications of such acts when conducted

[26] See for instance Congressional Research Service, *Government Expenditures on Defense Research and Development by the United States and Other OECD Countries: Fact Sheet*, January 28, 2020 (Washington, D.C.: Government Printing Office), pp. 1-3.

successfully. But transferring the engineering and physics of nuclear fission is different from the complex engineering and manufacturing of a complex system of systems such as the US's F-35 stealth fighter. Indeed, many of the challenges in producing MWS lie in the complex material science and manufacturing as is the case in high-performance aircraft engines. Lastly, it is unknown as to what extent espionage, particularly cyber espionage, supplants traditional R&D as states do not disclose such information.

Tertiary education enrollment rates are incorporated as a measure of human capital. Human capital is essential to military industrial capacity which requires high levels of highly educated and specialized scientists, engineers, and technicians. Expansion of higher education should precede increases in technological capacity. In developing states human capital is difficult to build and maintain. Insufficient levels of human capital are likely to hinder military-industrialization, which must also compete with private-sector demand as well as emigration, or intellectual "brain drain."[27] Tertiary enrollment rates broadly determine the public labor pool. In the case of China and India, tertiary rates automatically skew towards STEM (science, technology, engineering, and math) degree programs. For the purpose of this study, the gross enrollment ratio for all tertiary programs is used.[28] Education data is drawn from the World Bank's DataBank of World Development Indicators as provided by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. This study uses the median score for each respective period of analysis. For example, Period 1 (1980-1984)

[27] Binod Khadria, "Skilled Labour Migration from Developing Countries: Study on India," *International Migration Papers* (Geneva: International Labour Office, 2002).

[28] According to UNESCO, "Gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Tertiary education, whether or not to an advanced research qualification, normally requires, as a minimum condition of admission, the successful completion of education at the secondary level." The World Bank, World Development Indicators.

uses the score for 1982 (4.97). In the event of missing or unreported data, the next available year is reported. The tertiary education indicator is suitable for determining access to highly trained human capital. The scores can also be used as another factoring when comparing to other developed states. Furthermore, the gross ratio may reflect trends in other education indicators such as increasing literacy rates and primary/secondary education completion. Where necessary, further indicators may be used to highlight similarities and/or differences across periods or cases. Enrollment rates for each period are measured and classified as low/moderate/high.

Major policy changes are those that directly impact the nature and/or operation of the military industrial complex. This may include, for example, broad changes such as reorganization of key arms industries or minor adjustments such as changes to foreign direct investment (FDI). Implementation of such policy changes can have positive or negative consequences on military industrial capacity. Each policy change is unique and requires contextualization. In light of economic liberalization, globalization, and changes in military technology, major policy changes and reform are essential to developing states and the establishment and expansion of military industrial capacity. Data for this indicator is collected from government documents and open sources. Policy changes for each period are measured and classified as none/minor/major. Table 2.3 below outlines the measurement and classification of these indicators.

Table 2.3: Military Industrial Capacity Indicators and Levels				
GDP	High-Technology Exports	Gross Tertiary Education Enrollment	Research & Development	Defense Policy Reforms
Low $0-500 bn	Low 0-10%	Low 0-15%	Low $0-1 bn	None
Moderate $501 bn to $1 tr	Moderate 11-20%	Moderate 16-30%	Moderate $1-3 bn	Minor
High $1+ tr Very High > $10 tr	High 20% and above	High 31% and above	High $3+ bn	Major

Together, these indicators broadly operationalize the necessary components of military industrial capacity and can be summarily classified as high/moderate/low. The thresholds for determining these classifications are derived from comparative figures and ranges established between economically developed (approximately the top 10-20 states) and developing states. For consistency, the thresholds are based on the best approximate baselines and ranges to cover the period 1980-2018. Different baselines could be established for shorter and more recent time periods such as 2008-2018. For GDP, the 15 largest world economies possessed a GDP above $1 trillion in 2018, thus categorizing them as high, while the approximately middle 50 percent of states possessed a GDP between $501 billion to $1 trillion (moderate). In terms of high-technology exports, the top 20 states, historically, possessed a figure above 20 percent (high) while the next 30-40 developing states averaged 10-20 percent (moderate). There is significant separation between the top 50-60 states and the rest, representing the low threshold below 10 percent. For gross tertiary education enrollment, the middle 50 percent of states historically measured 16-30 percent (moderate), while the top 15-20 states were above 30 percent (high) during this period of analysis.[29] For military R&D, the thresholds are based on a narrower sample of MWS and high-technology exporting states (approximately 10-15) as most states do not invest extensively in military R&D. Because the gap is so large between the top arms producing states and the rest (90 percent of states fall below $1 bn), distinction between moderate and high is primarily determined by comparative rates between the top 5 percent of states and the top 1 percent (Russia and the US). Finally, defense policy reforms are measured according to their impact on the force structure and defense industry. For example, significant personnel reductions (>250,000) and widespread re-organization of the defense industry are categorized as major reforms. Marginal changes to specific policies or programs are categorized as minor.

As Tables 2.4 and 2.5 demonstrate, China and India both possessed low levels of military industrial capacity until the mid-1990s, thus constraining their abilities to indigenously develop and produce MWS. China saw improvement in this variable after 1995 while India did not experience substantial improvement until 2005. These patterns correlate with the respective increases in military modernization rates in both cases.

Table 2.4: Military Industrial Capacity in China

Time Period	GDP	High-Technology Exports	Tertiary Education	Research & Development (Average)	Policy Reforms	Summary of Relative Military Industrial Capacity
Period 1 (1980-1984)	Low $203 bn	Low N/A	Low 2%	Low $500 mil	Major	Low
Period 2 (1985-1989)	Low $270 bn	Low N/A	Low 3%	Low $500 mil	Major	Low

[29] It is important to note that this indicator has changed more than any other across the international community, particularly since 2000 as gross tertiary education enrollment has skyrocketed in many countries, with many exceeding 60 percent by the World Bank's definition. The thresholds in this study were thus determined on the best estimated ranges to cover 1980-2018.

Period 3 (1990-1994)	Low / near Moderate $423 bn	Low 6%	Low 3%	Moderate $1 bn	Minor	Low
Period 4 (1995-1999)	Moderate / near High $953 bn	Moderate 13%	Low 6%	Moderate $2 bn	Major	Moderate
Period 5 (2000-2004)	High $1.5 tr	High 24%	Low 12%	High $4 bn	Minor	Moderate
Period 6 (2005-2009)	High $3.5 tr	High 27%	Moderate 20%	High $8 bn	Minor	High
Period 7 (2010-2014)	High / near Very High $9 tr	High 27%	High 30%	High $10 bn	Minor	High
Period 8 (2015-2018)	Very High $11.5 tr	High 29%	High 32%	High $12 bn	Moderate	High

Table 2.5: Military Industrial Capacity in India

Time Period	GDP	High-Technology Exports	Tertiary Education	Research & Development (Average)	Policy Reforms	Summary of Relative Military Industrial Capacity
Period 1 (1980-1984)	Low $198 bn	Low N/A	Low 5%	Low $190 mil	None	Low
Period 2 (1985-1989)	Low $276 bn	Low 4%	Low 6%	Low $285 mil	None	Low
Period 3 (1990-1994)	Low $246 bn	Low 4%	Low 6%	Low $328 mil	Major	Low
Period 4 (1995-1999)	Low / near Moderate $411 bn	Low 7%	Low 7%	Low $440 mil	None	Low
Period 5 (2000-2004)	Moderate $507 bn	Low 6%	Low 10%	Low $529 mil	Major	Low
Period 6 (2005-2009)	High $1.2 tr	Low 6%	Moderate 13%	Moderate $1.2 bn	Minor	Moderate
Period 7 (2010-2014)	High $2 tr	Low 8%	Moderate 25%	Moderate $2 bn	Minor	Moderate
Period 8 (2015-2018)	High $2.5 tr	Low 9%	Moderate 27%	Moderate $2.3 bn	Moderate	Moderate

Available Foreign Suppliers

The availability of foreign suppliers is defined as the ability to legally import MWS and technology by official means from arms exporting states. This is an important variable for states that do not possess the adequate military industrial capacity to build their own MWS. Foreign suppliers are also necessary to transfer advanced technologies that developing states do not readily possess. Thus, the greater the availability of foreign suppliers, the more a state can modernize its armed forces. Conversely, if foreign suppliers are unavailable, military modernization is hindered—forcing defense planners to rely on subpar indigenous arms or seek alternative methods of acquisition. For example, following the 1989 Tiananmen Square crisis and 1996 Taiwan Strait crisis, China was consistently constrained by inaccessibility to foreign arms and technology.[30] By examining foreign suppliers and trade relationships, this variable can be measured and classified as high/moderate/low. Data for this variable is collected from government documents and the SIPRI Arms Transfer Database. This variable is operationalized by aggregating the following three indicators.

First, it is determined if there are any foreign embargoes or sanctions against the importer and what states are participating. Since LDCs are reliant on these importers for military modernization, this indicator perfectly illustrates the dependency problem in LDCs. Embargoes can significantly constrain military modernization. In this study, China has been the primary target of military technology embargoes. The Soviet Union prohibited trading with China following the Sino-Soviet split in 1960 until the end of the Cold War. This was succeeded by a

[30] Joseph P. Gallagher, "China's Military Industrial Complex: Its Approach to Acquisition of Military Technology," *Asian Survey*, Vol. 27, No. 9 (Autumn 1987), pp. 991-1002; and Paradorn Rangsimaporn, "Russia's Debate on Military-Technological Cooperation with China: From Yeltsin to Putin," *Asian Survey*, Vol. 46, No. 3 (Summer 2006), pp. 477-495.

US and European embargo following the Tiananmen Square massacre in 1989 which remains in effect. India was also affected, albeit only briefly, by US sanctions after its 1998 nuclear tests.

Second, it is determined whether the state has implemented a policy of import-substitution, thus potentially affecting foreign arms supply. Since the early 1970s, India avoided trading with certain Western partners, such as the US, out of fear of being cut-off from supplies during crises. This fear of dependency and vulnerability contributed to India's import-substitution policies as a means to protect and encourage indigenous arms production. India also implemented restrictive policies that discouraged foreign investment and importation of high-end goods in order to service the policy of self-sufficiency. As a result, India limited itself from importing MWS and technology from major arms supplier states. For the relevant years when these policies were followed, India's ability to acquire and absorb advanced military technology was negatively impacted. This indicator is categorized by a simple Yes/No as it serves to represent a key policy distinction between the selected cases and does not vary significantly throughout the periods.

Third, the top arms suppliers are determined for each case and the nature of their arms transfer relationship. States with more diverse trade relationships may be expected to have higher rates of military modernization due to greater competition and selection. This indicator may also include joint ventures between foreign arms companies. These agreements often include technology transfers and divisions of manufacturing. For example, India has engaged in multiple joint ventures with Russia, including the manufacture of MiG-21 and Su-27 fighters.

Together, these three factors operationalize the availability of foreign supply and can be summarily classified as high/moderate/low depending on the relative availability of foreign suppliers for that period and the extent of their defense trade relationship. Low available foreign supply primarily corresponds to the presence of embargoes and low defense trade with available foreign suppliers. For example, China has faced multiple embargoes, and while Russia has supplied MWS since the collapse of the Soviet Union, the extent of that relationship has steadily declined (in large part due to Russian fears over China's reverse-engineering Russian MWS). Conversely, high available foreign supply is characterized by numerous major foreign arms suppliers, no embargoes, and extensive access to top MWS. These factors represent relative levels for each indicator per time period rather than absolute levels. Low availability of foreign suppliers is a considerable limitation to military modernization. Meanwhile, higher availability of foreign suppliers translates into greater opportunity for states to pursue military modernization. As Tables 2.6 and 2.7 demonstrate, China experienced lower availability of foreign suppliers compared to India. Low availability of foreign suppliers has constrained China's ability to import MWS and technology. This limitation has been partially mitigated with increased trade with Russia after 1990. Unlike China, India has benefited from higher availability of foreign suppliers leading to more consistent military modernization; however, this factor has been partially offset by India's inclination for import-substitution policies. At least in practice, India favors domestic arms procurement over foreign.

Table 2.6: Available Foreign Supply in China

Time Period	Embargoes (Participating States)	Import-Substitution Polices	Top Arms & Tech Suppliers	Summary of available foreign supply
Period 1 (1980-1984)	USSR	No	US, UK, Germany	Low
Period 2 (1985-1989)	USSR	No	US, UK, France, Germany	Low
Period 3 (1990-1994)	US, Europe	No	Russia, Germany	Low-Moderate
Period 4 (1995-1999)	US, Europe	No	Russia, Ukraine, Israel	Low-Moderate

Period 5 (2000-2004)	US, Europe	No	Russia, Ukraine, France	Moderate
Period 6 (2005-2009)	US, Europe	No	Russia, Ukraine	Low
Period 7 (2010-2014)	US, Europe	No	Russia, France, Germany	Low
Period 8 (2015-2018)	US, Europe	No	Russia, France, Germany	Low

Table 2.7: Available Foreign Supply in India

Time Period	Embargoes (Participating States)	Import-Substitution Policies	Top Arms & Tech Suppliers	Summary of available foreign supply
Period 1 (1980-1984)	N/A	Yes	USSR, UK, France, Germany	High
Period 2 (1985-1989)	N/A	Yes	USSR, UK, France, Germany	Moderate
Period 3 (1990-1994)	N/A	Yes	Russia, UK, Germany	Moderate
Period 4 (1995-1999)	US[1]	Yes	Russia, UK, Israel	Low-Moderate
Period 5 (2000-2004)	N/A	Yes	Russia, Israel, France, UK	Moderate
Period 6 (2005-2009)	N/A	Yes	Russia, US, Israel, France, Germany	High
Period 7 (2010-2014)	N/A	Yes	Russia, US, U.K., Israel, France	High
Period 8 (2015-2018)	US (Indirect)[2]	Yes	Russia, US, U.K., Israel, France	High

[1] The US imposed economic sanctions following the 1998 nuclear weapons tests but removed them by 2001.

[2] The US imposed sanctions against Russia in late 2016 following election interference, which had the impact of indirect sanctions on Russia's arms recipients and complicated Russian arms sales to India.

Military Obsolescence

Military obsolescence is the standard process of MWS becoming out of date or inoperable. MWS can also become technologically obsolete if they are no longer state-of-the-art and are easily defeated by newer capabilities. Military obsolescence affects military modernization in three ways. First, aging force structures prompt defense planners to pursue replacement arms or implement upgrade/refit programs.[31] Because of cost efficiency, the latter option is preferred, but can be circumvented if modern technology cannot be adapted. Second, imminent block obsolescence of MWS will influence a state's move to foreign arms procurement, especially if no viable domestic alternative is readily available. Due to the nature of defense planning and the arms procurement process, developing near-instantaneous remedies to gaps in capabilities is extremely difficult. The inadequacies and unreliability of domestic arms industries frequently contribute to the delay of projected arms procurement. Third, major advancements in military technology or RMA may render older weapons systems inadequate and lead to vulnerabilities in national defense. This factor is compounded if rival states acquire new tactical advantages.

Military obsolescence is calculated using a combination of block and technology obsolescence. The US military determines obsolescence through a generalized framework known as military service life assessment programs (SLAP). The US military's extensive investment and research into SLAP has produced a general model for estimating the expected service life of certain MWS. For instance, fighter aircraft typically have a service life of 6,000-8,000 flight hours. Based on a schedule of 200 peacetime flight hours per year, a fighter aircraft may expect

[31] Richard A. Bitzinger, ed., *The Modern Defense Industry: Political, Economic, and Technological Issues* (New York, N.Y.: Praeger Security International, 2009), p. 315. Most militaries have an established baseline minimum for national defense.

to serve 30 years. There are some exceptions, however, such as the US B-52 bomber which has remained in service for over 65 years.

Block obsolescence (sometimes referred to generally as force structure maturity) is directly tied to the life-cycle management of each MWS.[32] All MWS have an estimated operational lifespan based on research and operational history. In other words, MWS have an unofficial expiration date without a service life extension program. The life cycle of MWS is determined by expected operational usage (hours, miles, rounds, etc.) and correlating deterioration (wear and tear) of the platform and subcomponents.[33] Lifespans are not definitive, and can increase or decrease depending on maintenance levels, use in combat, total training usage, and upgrades. By analyzing the nature and age of a state's military force structure, military obsolescence can be classified as high/moderate/low. This is aided by patterns in the life cycles of MWS. These patterns, drawn from multiple sources, are demonstrated in Table 2.8.[34]

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[32] Life-cycle management programs are subject to multiple obstacles, however: changing mission requirements; outdated computers and software; first-generation, obsolete open architecture (VME) systems; short supply of spare parts; and escalating maintenance costs.

[33] See for instance, Ministry of Defense of India, "Technology Perspective and Capability Roadmap (TPCR)," (New Delhi: Ministry of Defense, 2018).

[34] US Department of Defense Office of Acquisition, Technology and Logistics, "Implementing Lifecycle Management Framework" (Washington, D.C.: Department of Defense, 2008); North Atlantic Treaty Organization Research and Technology Organization, "Cost Structure and Life Cycle Cost for Military Systems" (Paris, France: NATO, 2003); and see also the US Department of Defense's Defense Acquisition University Life Cycle Management Program. These patterns represent an approximation of peacetime operability, which can be disrupted by extended combat operation or inadequate maintenance programs. See US Department of Defense, "Impact of Military Operational Tempo on Military Equipment Useful Life and Associated Reconstitution and Maintenance Costs" (Washington, D.C.: Department of Defense, 2007).

Table 2.8: Peacetime Service Life of MWS			
MWS Category	Annual Operating Average	Projected Service Life	Service Life (Years)
Main battle tanks	300 miles	6,000 miles	20
Attack aircraft	2-300 hrs	9,000 hrs	30-35
Bomber aircraft	3-400 hrs	20,000 hrs	30-40
Transport aircraft	1,000 hrs	30,000 hrs	30
Helicopters	5-600 hrs	9-10,000 hrs	20
Submarines	150 days	40-45 yrs	40-45
Frigates	180 days	35 yrs	35
Destroyers	180 days	35 yrs	35
Aircraft carriers	150 days	50 yrs	50

For example, it is understood that most well-built fighter aircraft have an expected life cycle of about 30 years. This is determined by a projected number of flying hours per year and anticipated deterioration of the airframe's durability.[35] For example, the American F-15 C/D has a service life of 9,000 hours and the USAF peacetime annual flight-hour average is set at 300 hours. However, most international operators of advanced fighter aircraft have much lower annual flight-hour averages.[36] As a result of these patterns in MWS service life, the above framework can be applied to assess the relative aging of force structures.[37] Using these projections, existing force structures can be assigned timeframes for aging military systems. These timeframes can then be used to project potential windows of obsolescence. Coupled with MWS quantities, percentages of total force structure obsolescence can be projected for each

[35] See for instance US Office of the Undersecretary of Defense, "Military Equipment Useful Life Study-Phase II" (Washington, D.C.: Department of Defense, 2008).

[36] This usually reflects efforts to minimize maintenance or a direct result of insufficient aircraft maintenance.

[37] This framework is based on Western operational histories and assessments; as a result, the average service life of MWS in developing countries may be less approximate due to insufficient technologies and/or maintenance.

period of observation. Data for this indicator is collected from *The Military Balance*, government documents, and open sources.

Technological obsolescence is observed by tracking advancements in military technology and opponent capabilities. Failure to keep pace with rapid advancements in technology can render MWS tactically vulnerable or obsolete by newer MWS or counter-weapons possessed by competitors. This is most common between generations of fighter aircraft.[38] Technological obsolescence typically develops in phases following the introduction or expansion of a particular capability (e.g., night vision, thermal imaging, depleted uranium munitions, laser-guided munitions, and stealth technology). Major changes in technology can force defense planners and policymakers to aggressively re-engage military modernization in order to minimize windows of vulnerability, or in some cases maximize advantages.[39] This factor attains greater importance in environments where security thresholds are low, including South Asia and the Taiwan Strait.

Military obsolescence can be summarily classified as high/moderate/low based on approximate age of force structures and subjective assessments of technological modernity/superiority. High military obsolescence is commonly indicated by declining force elements, i.e., reducing fleet sizes or aircraft squadrons. Moderate military obsolescence is commonly signified by new arms development programs or open competitions and tenders for future replacement, which are further represented in public defense strategic reports and statements. These represent relative levels for each indicator per time period rather than absolute

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[38] For more on the evolution of fighter aircraft see Richard A. Bitzinger ed., *The Modern Defense Industry: Political, Economic, and Technological Issues*, pp. 306-308; and Air Power Development Centre, "Five Generations of Jet Fighter Aircraft," *PathfinderI,* No. 170 (January 2012).

[39] Timothy D. Hoyt, "Technology and Security," in Michael E. Brown, ed., *Grave New World: Security Challenges in the 21st Century* (Washington, DC: Georgetown University Press, 2003), pp. 17-37.

levels. Values for Military Obsolescence are shown in Tables 2.9 and 2.10. Both China and India have experienced overall moderate or high levels of military obsolescence.

Table 2.9: Military Obsolescence in China			
Time Period	Force Structure/ Block Obsolescence	Technological Obsolescence	Summary
Period 1 (1980-1984)	Moderate	High	Moderate-High
Period 2 (1985-1989)	Moderate	High	Moderate-High
Period 3 (1990-1994)	Moderate	High	High
Period 4 (1995-1999)	High	High	High
Period 5 (2000-2004)	High	High	High
Period 6 (2005-2009)	High	Moderate-High	High
Period 7 (2010-2014)	Moderate-High	Moderate	Moderate-High
Period 8 (2015-2018)	Moderate	Moderate	Moderate

Table 2.10: Military Obsolescence in India			
Time Period	Force Structure/ Block Obsolescence	Technological Obsolescence	Summary
Period 1 (1980-1984)	Moderate-High	High	High
Period 2 (1985-1989)	Moderate	Moderate	Moderate
Period 3 (1990-1994)	Moderate	Moderate	Moderate
Period 4 (1995-1999)	Moderate	Moderate	Moderate
Period 5 (2000-2004)	High	Moderate	High
Period 6 (2005-2009)	High	High	High

Period 7 (2010-2014)	High	Moderate-High	High
Period 8 (2015-2018)	High	Moderate	High

Security Threat Environment

The security threat environment is an important motive for military modernization, and it is shaped by perceptions of security threats and political ambitions in two ways.[40] First, arms acquisition is guided by the technological combat capabilities of adversaries. States seek adequate military power, either superiority or parity, over their rivals in order to ensure survival. Second, the intensity of military modernization is influenced by the degree of conflict or escalatory relations with potential threats. Therefore, if tensions in the security threat environment are elevated then the demand for modernization is intensified, and vice-versa. Thus, the security threat environment can be categorized as high/moderate/low depending on the balance of capabilities and degree of tensions between rival states. Some studies note that states evaluate the security threat environment by identifying four criteria: (1) Aggregate power; (2) proximate power; (3) offensive power; and (4) offensive intentions.[41] These variables are adapted and condensed below into three relevant indicators: national capabilities; regional instability; and changes in opponent capabilities.

First, national capabilities are defined as a state's total resources including population, military expenditure, and industrial capability. This indicator is measured using the Composite

[40] Hoyt, *Regional Defense Policy*, pp. 15-16.

[41] For the purpose of this study Walt's four variables are adapted and condensed into three: national capabilities; regional instability; and opponent capabilities.

Index of National Capabilities (CINC) from the Correlates of War project.[42] [43] The CINC indicator is derived from six factors in the National Material Capabilities (NMC) dataset: population, urban population, iron and steel production, energy consumption, military personnel, and military expenditure.[44] The index represents the proportion of the total material capabilities across the international system possessed by each state at a given time.[45] For comparison of the top five powers, an additional indicator is created—Top 5 Proportionality, or T5-Prop. This indicator sorts the CINC scores according to rank, separating the top five states and measuring their total national capabilities in proportion to each other. Prior to and during 1980-2012, the top five countries as measured by CINC account for, on average, 50 percent of the world's total power/capabilities. This allows for greater examination of the changing dynamics between the top five major powers over time, and the relative change between China and India. CINC rankings and percentages are reported for each case along their respective T5-Prop score. Measures of T5-Prop are categorized as high/moderate/low: low at less than 25 percent; moderate at 26-39 percent; and high at greater than 40 percent.

Second, regional instability is based on actual or perceived aggressive behavior. This is determined by past experiences and official statements or declarations of policy. For example, in

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[42] All data is derived from NMC version 5; David J. Singer, "Reconstructing the Correlates of War Dataset on Material Capabilities of States, 1816-1985," *International Interactions*, No. 14 (1987), pp. 115-32.

[43] The index is commonly used as a measure of system polarity and power distribution. See for instance Bruce Bueno de Mesquita, *The War Trap* (New Haven, CT: Yale University Press, 1983); Tammen, Ronald L., Jacek Kugler, Douglas Lemke, Allan C. Stam III, Carole Alsharabati, Mark Andrew Abdollahian, Brian Efird, and A. F. K. Organski, *Power Transitions: Strategies for the 21st Century* (New York: Seven Bridges Press, 2000); and Robert Stewart-Ingersoll and Derrick Frazier, *Regional Powers and Security Orders: A Theoretical Framework* (New York: Routledge, 2011).

[44] Beyond the use of the general CINC indicator, all military expenditure figures are derived from the SIPRI Military Expenditure Database.

[45] Values for the NMC dataset only includes observations up to 2012.

1995 and 1996 China test-launched dozens of ballistic missiles over the Taiwan Strait. The tests were publicly condemned by the US and Taiwan. The US further responded by deploying two aircraft carrier battle groups into the region. These events significantly destabilized relations in the region. Using context analysis, regional instability for each period is measured and classified as high/moderate/low depending on the severity of threat and official reactions. Ultimately, low regional instability is expected to contribute less to military modernization while escalating tensions, or high instability, is likely to promote military modernization. Regional instability is categorized as high/moderate/low: low – absence of a destabilizing threat; moderate – presence of a destabilizing threat; and high – presence of overt threat to national interests.

Third, opponent capabilities—a combination of proximate power and offensive power—operationalize the ability of states to strike militarily within a geographic area. This is determined by the positioning of military forces and their respective offensive capabilities. Prior scholarship reveals that states are highly perceptive of the changing capabilities of their neighbors and strategic rivals.[46] An increase in the capabilities of a rival, particularly offensive power, will likely trigger greater emphasis on military modernization in the target state. Data for this factor is collected from open sources and official statements by military and government officials. This information is measured and categorized as high/moderate/low: low – no significant change; moderate – possible advantageous change in opponent capabilities; and high – destabilizing change in opponent capabilities.

Together, these three factors characterize the security threat environment which can be summarily classified as high/moderate/low. These represent relative levels for each indicator per time period rather than absolute levels. Tables 2.11 and 2.12 summarize the security threat

[46] Robert Jervis, "Cooperation Under the Security Dilemma," *World Politics* Vol. 30, No. 2 (1978), pp. 186-214; and John J. Mearsheimer, *The Tragedy of Great Power Politics* (New York: Norton, 2001), pp. 32-36.

environment for China and India, respectively. In China, there was a low security threat environment in Periods 1-3 (1980-1994), and a moderate or high-threat environment thereafter. In India, the security threat environment was mostly moderate or high-threat across the time-periods with the exception of Period 3.

Table 2.11: China Security Threat Environment

Time Period	National Capabilities*		Regional Instability	Growth in Opponent Capabilities	Summary
	CINC	T5-Prop			
Period 1 (1980-1984)	3rd, 12%	22%	Low	Low	Low
Period 2 (1985-1989)	3rd, 11%	21%	Low	Low	Low
Period 3 (1990-1994)	2nd, 12%	26%	Low	High	Moderate
Period 4 (1995-1999)	1st, 14%	31%	High	High	High
Period 5 (2000-2004)	1st, 17%	35%	High	High	Moderate-High
Period 6 (2005-2009)	1st, 20%	40%	Moderate	Moderate	Moderate
Period 7 (2010-2014)	1st, 22%	42%	Moderate	Moderate	Moderate
Period 8 (2015-2018)	N/A	N/A	High	Moderate	Moderate-High

* The CINC identifies the international ranking of China in terms of its total national capabilities and notes its global share of capabilities as a percentage. The T5-Prop represents China's relative CINC amongst the top five states.

Table 2.12: India Security Threat Environment

Time Period	National Capabilities[1]		Regional Instability	Growth in Opponent Capabilities	Summary
	CINC	T5-Prop			
Period 1 (1980-1984)	4th, 5%	10%	High	High	High
Period 2 (1985-1989)	4th, 6%	11%	Moderate	Moderate	Moderate
Period 3 (1990-1994)	4th, 6%	14%	Low	Low	Low

Period 4 (1995-1999)	3rd, 7%	14%	High	High	High
Period 5 (2000-2004)	3rd, 7%	15%	High	Moderate-High	High
Period 6 (2005-2009)	3rd, 8%	16%	Moderate	Moderate-High	Moderate
Period 7 (2010-2014)	3rd, 8%	16%	Moderate	High	Moderate-High
Period 8 (2015-2018)	N/A	N/A	Moderate-High	High	Moderate-High

[1] The CINC identifies the international ranking of India in terms of its total national capabilities and notes its global share of capabilities as a percentage. The T5-Prop represents India's relative CINC amongst the top five states.

2.5 Summary

This chapter has outlined the concepts of military industrial capacity, availability of foreign suppliers, military obsolescence, and the security threat environment and their respective impact on military modernization. The next chapters explore how these factors influence military modernization in China and India from 1980 to 2018.

Chapter III

Military Modernization in India

Stagnation and progress in India's military modernization is influenced by changes in military industrial capacity, foreign supply, military obsolescence, and the security threat environment. Over the time-periods since 1980, India's military modernization stagnates when combinations of these variables register low but progresses when combinations of these variables register moderate to high. These variables are shown in Table 3.1 and the discussion below.

Table 3.1: Summary of Variables—India

Year	Military Industrial Capacity	Available Foreign Supply	Military Obsolescence	Security Threat Environment	Military Modernization
Period 1 (1980-1984)	LOW	HIGH	HIGH	HIGH	MODERATE / NEAR HIGH
Period 2 (1985-1989)	LOW	MODERATE	MODERATE	MODERATE	LOW
Period 3 (1990-1994)	LOW	MODERATE	MODERATE	LOW	LOW
Period 4 (1995-1999)	LOW	LOW-MODERATE	MODERATE	HIGH	LOW
Period 5 (2000-2004)	LOW	MODERATE	HIGH	HIGH	MODERATE / NEAR HIGH
Period 6 (2005-2009)	MODERATE	HIGH	HIGH	MODERATE	HIGH
Period 7 (2010-2014)	MODERATE	HIGH	HIGH	MODERATE-HIGH	HIGH
Period 8 (2015-2018)	MODERATE	HIGH	HIGH	MODERATE-HIGH	HIGH

During the period 1980 to 1984, India's military modernization was moderate and near high corresponding with an unstable security threat environment and favorable arms supply relationships with the Soviet Union and United Kingdom (UK). In the period 1985 to 1989, military modernization was low at a time of moderate security threat environment, moderate military obsolescence, and moderate foreign supply. In the period 1990 to 1994, military modernization remained low when there was low military industrial capacity and moderate availability of foreign suppliers. Likewise, improvements in the security threat environment contributed to lower demand for military modernization. In the period 1995 to 1999, military modernization remained low at a time of low-moderate availability of foreign suppliers and despite a high security threat environment. In the period 2000 to 2004, military modernization rose sharply to moderate and near the high threshold when there were high levels of military obsolescence and high concerns related to the security threat environment. In the period 2005 to 2009, these conditions continued to rise along with moderate levels of military industrial capacity and high availability of foreign suppliers, contributing to a high level of military modernization. In the period 2010 to 2014, military modernization was high when there was high available foreign supply, high military obsolescence, and moderate-high security threat environment. Finally, in the period 2015 to 2018, military modernization was high when there was high available foreign supply, high military obsolescence, and moderate-high security threat environment. Thus, military modernization in India was highest in the periods 1980-1984, 2010-2014, and 2015-2018 when multiple independent variables registered high.

The following section provides background information on India's defense policies and the transition over time to somewhat greater military self-reliance. This is followed by an analysis of eight periods of military modernization in India. The final section develops the analytic conclusions for the India case.

3.1 Background on Indian Defense Policy

India's history related to defense policy and military modernization approach is complicated. Its status as a democracy, former British colony, resource rich, nuclear power, and a leader in the non-aligned movement ought to make India a strong player in military modernization. However, several factors were detrimental or contradictory to India's plans.

First, India's policy of self-reliance is rooted in its colonial past and early post-independence conflicts. As a result of British imperialism, the military plays a limited role in policymaking by design. After independence, India fought four major conflicts in its first 25 years: three with Pakistan (1947, 1965, 1971) and one with China (1962). Through each of those conflicts India was reliant on foreign arms. Throughout the Cold War, India and many other states sought a policy of self-reliance after the Soviet and Western blocs cut off weapons supplies, sometimes in the middle of conflicts.[1]

Second, the dual objectives of self-reliance and limited military influence in politics have resulted in high levels of civilian authority in all realms of defense planning.[2] The arms procurement process is subject to the competing interests and influence of three groups: the military, civil bureaucrats and politicians, and economists.[3] These three groups openly compete for influence in national security matters and the limited availability of financial resources, and often function as a system of checks and balances.

This competition has resulted in three distinct defense policy preferences. The military's primary objective is to achieve, at a minimum, parity in capabilities with potential adversaries. The simplest path to achieving this goal is procure the newest and most advanced weapons from

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[1] Both the US and Soviet Union leveraged arms sales for desired political outcomes throughout the Cold War. This line of research was also a significant extension of studies on the Cold War international arms trade. Throughout this period there was a wide proliferation of LDC arms suppliers.

[2] Ashley J. Tellis, "India: Capable but Constrained," in Gary J. Schmitt, *A Hard Look at Hard Power: Assessing the Defense Capabilities of Key US Allies and Security Partners—Second Edition* (Carlisle, PA: US Army War College Press, 2020).

[3] Raju G.C. Thomas, *Indian Security Policy* (Princeton, N.J.: Princeton University Press, 1986), pp. 246-247.

overseas. Politicians, on the other hand, prefer to assert independence in defense policy via technological self-reliance, and thereby ensuring contracts for constituents. Finally, economists prefer to find a balance between the cost and quality of arms, which is typically best achieved through licensed production of foreign weapons. As a result of these preferences, India's weapons procurement policies can be categorized and examined in terms of importation, indigenous production, and licensed production.

Third, Indian military modernization planners underestimated the significance of technological diffusion and integration. In the mid-1970s, following prior conflicts and unreliable partners, India shifted its defense policies from self-sufficiency to aiming for self-reliance. The prior conflicts taught Indian policymakers that the nation could not simply rely on quantitative advantages or risk dependency on foreign suppliers for critical armaments. A short-term buildup in capabilities and greater investment in R&D ensued. This resulted in fewer arms imports from Great Britain and many more from the Soviet Union, which was viewed as a more reliable supplier. But these agreements often lacked technology transfer and instead transferred dependency from the West to the Soviet Union. Furthermore, the West was laying the foundation for a revolution in military affairs (RMA) in the 1980s while the Soviet Union was headed towards collapse, thus worsening some technological gaps.

Fourth, India's pursuit of international prestige frequently conflicts with its domestic agenda and its history as a non-aligned state. Capital-intensive military modernization detracts resources from other economic development priorities, notably education, healthcare, and infrastructure. Yet, India often views itself as a major power within the international community, resulting in a high premium on achieving military self-reliance, both as a security imperative but also as a symbolic objective.[4] Consequently, this objective appears to "prioritize symbol over substance" due to inadequate investment and conflicting defense priorities.[5] In many ways, India is a capable but constrained power.[6]

3.1.1 *Organization of India's Military Industrial Complex*

India's emphasis on independence and civilian control of the military was reinforced in the establishment of its nascent military industrial complex. The Science Research and Development Organization was formed shortly after independence in order to assist the military in developing defense related technology. In 1952, the Defense Science Service was created in order to foster young scientists and later recruit them for defense projects. In 1958, a series of reforms consolidated the R&D departments of the three armed services with the Science Research and Development Organization, now called the Defense Research and Development Organization (DRDO). After 1960, all of the DRDO's projects were overseen by the Defense Minister's Research and Development Committee. Today, the DRDO operates 48 laboratories and employs over 30,000 personnel including 5,000 scientists and engineers. The DRDO also maintains relationships with nearly 2,000 "research establishments," including many academic institutions. Many of these establishments receive special grants and promote defense-related projects. In addition, the DRDO conducts research for other organizations that do not possess in-house R&D capabilities, including the various ordnance factories.

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[4] See for instance David Kinsella and Jugdep S. Chima, "Symbols of Statehood: Military Industrialization and Public Discourse in India," *Review of International Studies*, Vol. 27, No. 3 (July, 2001), pp. 353-373.

[5] Stephen P. Cohen, *India: Emerging Power* (Washington, DC: Brookings Institution Press, 2001), pp. 127-156.

[6] Ashley J. Tellis, "India: Capable but Constrained," in Gary J. Schmitt, *A Hard Look at Hard Power: Assessing the Defense Capabilities of Key US Allies and Security Partners—Second Edition* (Carlisle, PA: US Army War College Press, 2020).

The origins of ordnance production began during British rule in India. The Ministry of Defense (MoD) took control of these facilities in 1948 until the Ordnance Factories Board (OFB) was officially established in 1979. The Board now operates 41 factories and employs over 99,000 personnel.[7] The Ordnance Factories are divided into five groups: the Clothing Group, the Ammunition Group, the Explosives Group, the Weapons Group, and the Vehicles Group, and are positioned throughout the country with most factories located in rural communities. Together, the Ordnance Factories supply nearly all of India's small and medium arms including guns, artillery, ammunition, rockets, anti-aircraft guns, and other basic supplies. They also produce a large portion of the armed services' patrol and transport vehicles, and armored personnel carriers. As a whole, the Army is the least dependent upon foreign arms, much to the credit of the Ordnance Factories. The weapons and supplies produced for them, however, are among the least technologically sophisticated or demanding to produce.

EXAMINING INDIA'S MILITARY MODERNIZATION

India's military modernization from 1980 to 2018 can be examined in eight periods: 1980-1984, 1985-1989, 1990-1994, 1995-1999, 2000-2004, 2005-2009, 2010-2014, and 2015-2018.

3.2 PERIOD 1: 1980-1984

3.2.1 Developments in Military Modernization

Table 3.2: Indian MWS, Period 1, 1980-84

Designation	Category	Supplier	Year	Quantity	Projected Estimated Value
MiG-23	Fighter	USSR	1980	100	$1,200
T-72	Tank	USSR	1980	500	$1,000

[7] Shishir Arya, "Defence production hit as Ordnance Factories face staff crunch," *Times of India*, November 19, 2012.

Shishumar class	Submarine	Germany	1980	4	$2,800
Jaguar	Attack Aircraft	UK-France	1982	116	$3,000
Mirage-2000	Fighter	France	1982	40	$2,100
Kashin-2	Destroyer	USSR	1982	2	$1,000
Mi-24	Helicopter	USSR	1982	12	$120
MiG-27	Attack Aircraft	USSR	1983	150	$2,000
Mi-17/171	Helicopter	USSR	1983	53	$800
Sindhughosh class	Submarine	USSR	1984	8	$2,000
IL-76M	Transport Aircraft	USSR	1984	20	$1,200
Total:*					**$17,000**

* Total rounded to nearest 500

In 1979, the Soviet Union invaded Afghanistan, altering regional geopolitics. The US gave Pakistan several billion dollars in military and economic aid in the subsequent decade, and also gave economic assistance to China. In 1980, Indira Gandhi and the Congress Party were elected to power following three years of a centrist coalition government. Indian security policy subsequently became more militarized and offense-oriented. In the 1980s, it was increasingly apparent that Pakistan was enriching weapons-grade nuclear material and building the bomb.[8] The Indian army began making efforts to reorganize and increase mechanization with the hopes of achieving rapid victory over Pakistan in any future conflicts.[9] In October 1984 Prime Minister Gandhi was assassinated following the aftermath of Operation Blue Star, and was succeeded by her son, Rajiv Gandhi.

At this time, India engaged in a concerted effort to modernize its military and achieve qualitative advantages over its adversaries. Total military expenditure averaged $12.6 billion per year. By the end of this period, major weapons system (MWS) procurement accounted for nearly

[8] "Pakistan Reported Near Atom Arms Production," *The Washington Post*, November 4, 1986.

[9] Prasun Sengupta, "Indian Armoured Doctrine and Modernization: Towards a Modern Armoured Capability," *Military Technology*, May 1992, pp. 29-35.

one-third of the total defense budget. Shifting away from earlier years of West-leaning arms procurement, in 1980, Prime Minister Indira Gandhi secured an arms package worth $1.63 billion (current dollars) from the Soviet Union which included highly favorable repayment options.[10] The Soviet Union became India's primary arms supplier, providing key major weapons systems such as jet fighters, submarines, heavy transport aircraft, ground attack aircraft, and tanks. France, Germany, and the UK also provided MWS.

First, the Indian Air Force (IAF) ordered over 100 Soviet MiG-23s, and then over 100 ground-attack versions of this plane that was designated Mig-27.[11] It also sought 40 French Dassault Mirage 2000s. The French Mirage fighters, ordered in 1982 (and entering into service starting 1985), gave the IAF much better air combat capabilities compared to its fleet of MiG-21s and Ajeet fighter jets. Additionally, it included an option for licensed production in India. More importantly, it provided a direct challenge to the American F-16A, which the Pakistani air force ordered one year prior. Despite the Mirage's superior capabilities, concerns persisted as a result of the aircraft's slow delivery schedule, prompting the MoD to shop for potential stopgap aircraft.[12]

Second, India ordered 116 Anglo-French Sepecat Jaguar ground attack aircraft. Two Jaguar deals in 1979 and 1982 allowed for co-production of the aircraft with an initial batch of

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[10] India received a two-year grace period and 15 years to repay, as opposed to ten-year Western custom, along with only a 2.5 percent interest rate payable in local currency. For more see Chris Smith, *India's Ad Hoc Arsenal: Direction or Drift in Defence Policy?* (New York: Oxford University Press for SIPRI, 1994), p. 111; and Honsa, C., "India gets USSR arms at bargain-basement prices," *Christian Science Monitor*, May 30, 1980.

[11] The first Mig-23s entered service in India in 1980-81 and they were phased out by 2009. About 10 Mig-27s were initially obtained from Russia, and about 100 were then assembled in India from Russian parts or otherwise made in India starting in the mid-1980s. The Mig-27 upgrade began in 2002, was completed in 2009, and the plane was retired by 2019.

[12] Thomas, *Indian Security Policy*, pp. 261-62.

40 aircraft being built in Great Britain and the rest in India using Hindustan Aeronautics Limited (HAL) kits. Over time, the English kits were replaced with greater Indian content.[13] India also negotiated for the MiG-29, which had not yet entered Soviet service, as a counter to the American F-16, and because the Mirages would not become operational quickly or in large numbers.[14]

Third, India procured two Soviet Kashin-2 naval destroyers (called Rajput-class in India).[15] At the time, India operated no destroyers, instead relying on an extensive fleet of frigates to patrol the Indian Ocean. The navy also ordered four Shishumar-class diesel-electric submarines from Germany and four Sindhughosh Kilo-class diesel-electric submarines from the Soviet Union. The 1980 contract with Howaldtswerke-Deutsche-Werft AGN (HDW) of Germany for the production of four Type 1500 (Shishumar-class) diesel attack submarines signaled a growing trend in India. In order to strengthen its indigenous arms industry, India sought joint production of MWS. The deal with HDW called for two submarines to be built in Germany and two in Bombay from German kits. This arrangement allowed hundreds of Indian technicians to be trained by German advisors and would potentially set the foundation for integrating Indian components over time.[16] India became the first foreign recipient of the Kilo in

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[13] For the initial 116 Jaguar aircraft, about 40 were delivered from the UK, beginning 1981; 45 more with new DARIN navigation / attack system were assembled in India, with their first flight in 1982; a further 31 were manufactured under license in India with first delivery in 1988.

[14] Smith, *India's Ad Hoc Arsenal*, p. 112; and Thomas, *Indian Security Policy*, p. 262.

[15] Three Kashin-class destroyers were already on order from the Soviet Union from 1976, and those were commissioned into the Indian navy in 1980-83. The two additional Kashins started construction in 1981-82 and were commissioned in 1986-87.

[16] The German-built vessels arrived on time in 1987. The Indian-built vessels were commissioned in 1991 and 1994 respectively. The first vessel entered service four years late while the second ran six years behind schedule due to constant construction delays and poor quality. Timothy D. Hoyt, *Military Industry and Regional Defense Policy: India, Iraq and Israel* (London: Routledge, 2006); and Amit Gupta,

1984 after it had entered service with the Soviet Union in 1980, representing the Soviet Union's most modern diesel-electric submarine.

Fourth, India ordered 20 IL-76 heavy-lift aerial transport aircraft and 53 Mil Mi-17 heavy-lift transport helicopters. The addition of the Ilyushin heavy transport planes was a major upgrade for the IAF. The backbone of the IAF's transport fleet was the light transport C-119 Flying Boxcar (of second world war vintage) and Antonov An-12, the latter of which possessed one-fourth the payload capacity of the IL-76 (46 tons) and shorter range. The Mi-17 is a medium-lift transport helicopter based on the Mi-8 frame, and also has a gunship/attack version (India had obtained about 100 Mi-8 helicopters in 1971-1988 that were mostly phased out by the 2000s). The helicopter achieved notoriety after forming the backbone of the Soviet army's operations in Afghanistan and showing its capability of operating in adverse terrains and conditions. These requirements were pivotal for enhancing operational capability in India's northern high-altitude and eastern desert terrains.

India also obtained 12 Mi-24 (sometimes designated Mi-25/35) attack helicopters from the Soviet Union; these were later augmented with an additional 20 in the late 1980s.

During this period, the overall structure of the Indian military changed little, with most modernization efforts focused on re-armament. In 1980, the Indian armed forces consisted of 1.1 million personnel and a defense budget of just $11.6 billion.[17] Over 90 percent of the military's manpower and 60 percent of its budget was devoted to the army. Together, two armored divisions operated 950 of the older Soviet T-54/55 and about 1,100 Vijayanta tanks (that were

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Building an Arsenal: The Evolution of Region al Power Force Structures (Westport, CT: Praeger, 1997), pp. 53-54.

[17] International Institute for Strategic Studies (IISS), *The Military Balance, 1980-1981* (London: IISS, 1982), p. 68.

licensed-built in India based on the British Vickers tank). In addition, the army began inducting the T-72 tank in the early 1980s—India initially purchased several hundred from the Soviet Union and then license-produced over 1,000 in India in the 1980s and 1990s. The Indian navy, with 47,000 personnel, operated 30 principal combat ships.[18] The majority of these ships were former surplus British or Soviet systems, including the former British Majestic-class aircraft carrier INS Vikrant. With 113,000 personnel, the IAF operated 630 combat aircraft organized into three light bomber squadrons and 31 fighter/ground-attack (FGA) squadrons. The majority of the bombers flown were variants of the British Canberra and the fighter squadrons were primarily equipped with about 250 Soviet MiG-21s in several variants.

3.2.2 Factors Contributing to Military Modernization

India's military modernization in 1980-1984 corresponded with certain conditions in its military industrial capacity, foreign supply, military obsolescence, and changes in the security threat environment.

Demand Variables

A combination of block obsolescence and technological obsolescence contributed to high military obsolescence for this period. In terms of block obsolescence, India's force structure was 60 percent obsolete due to aging fleets of legacy arms. Following independence in 1947, India enjoyed a decade's worth of wholesale arms imports from the UK. Large quantities of these arms transfers were surplus weapons from World War II and suspended platforms in the early stages of production. Table 3.3 highlights many of these arms transfers.

[18] This excludes 8 ex-Soviet Foxtrot-class submarines and four ex-Soviet Nanuchka corvettes.

Table 3.3: Select Arms Transfers from the UK			
Designation	**Category**	**Year**	**Quantity**
EWP	Destroyer	1950	3
Vampire FB-5	Fighter Jet	1950	333
Hunt-class	Frigate	1952	3
Vampire NF-10	Fighter Jet	1952	17
Blackwood-class	Frigate	1954	3
Leopold-class	Frigate	1954	3
Centurion-3	Tank	1955/1956	220
Canberra B(I)-8	Bomber	1957	66
Hunter F-56	Fighter Jet	1957	182
Majestic	Aircraft Carrier	1957	1
Gnat MK-1	Fighter Jet	1956/1958	200
Vijayanta	Tank	1961	2277

By the early 1980s, many of these arms surpassed their operational lifespans and/or became too expensive to maintain. To offset some of these issues before then, India began licensed production of many MWS including the Vijayanta, Folland Gnat, Vampire FB-5s, and HS-748 transports. These, however, quickly became technologically obsolete by the 1970s.

By 1980, much of India's armed forces faced high levels of technological obsolescence related to supplier and opponent armed forces. Throughout the 1970s, both the Soviet Union and the US made significant advancements in military technology. In 1978, the US approved the F-16, a lightweight multirole fighter aircraft, for operational clearance thus certifying the fourth-generation aircraft for production. The aircraft featured advanced fly-by-wire flight control, Westinghouse AN/APG-66 fire-control radar, and a highly efficient Pratt & Whitney F100-PW-200 powerplant. The F-16 would become a significant threat after Pakistan acquired the aircraft in 1980. The IAF primarily operated second generation fighters such as the MiG-21 and Hawker Hunter, each limited to interceptor duties.

Likewise, India's eight Foxtrot class diesel-electric attack submarines could not operate beyond coastal patrol missions because of their inability to avoid detection. This early 1960s era submarine class was easily tracked by the more advanced Soviet Victor and Alpha classes as well as the US Ohio class attack submarines. In addition, further advancements such as the Aegis Combat System (US), air-independent propulsion (USSR & Germany), and integrated night vision combat systems (US) broadened the technological gap between India and the West. US-Pakistani relations and arms transfers consequently magnified this factor.

Several changes prompted a high regional security threat environment, promoting military modernization in three ways. First, US-India relations grew contentious throughout the 1970s, particularly after the 1971 USS Enterprise “intervention” in the Bay of Bengal. The US’s demonstration of gunboat diplomacy was perceived as being able to thwart India’s blockade of Karachi during the 1971 war. This caused deep consternation and reminded Indian officials of European intervention 300 years earlier.[19] Second, the Soviet Union’s invasion of Afghanistan in 1979 escalated tensions throughout the region. Third, the invasion drove US-Pakistani relations closer together. US arms packages to Pakistan during the 1980s were worth several billion.[20] Indian security policy subsequently shifted towards greater assertiveness following Indira Gandhi’s return to power in 1980. As a result of these developments regional instability increased sharply with the potential for escalatory conflict.

The growth in Pakistan’s military capabilities became a particular concern for Indian policymakers. Among the arms packages received from the US were 40 F-16A fighter jets, four Gearing-class destroyers, and 100 M48A5 Patton tanks, along with millions of dollars more in missiles and small arms. Pakistan’s acquisition of the F-16 and other arms shifted the qualitative

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[19] Cohen and Dasgupta, *Arming Without Aiming*, pp. 75-76. The episode also reiterated the vulnerability of military dependence through resupply from the major arms suppliers.

[20] Arms Transfers Database, Stockholm International Peace Research Institute (SIPRI), accessed November 2020.

power balance in its favor. In addition, France and China supplied Pakistan with Agosta submarines and MiG-17s, respectively.

India's national capabilities put it at a further disadvantage respective to the US, Soviet Union, and China. Despite possessing the fourth largest standing army in the world, India's defense budget only averaged $12.6 billion throughout this period, making it only the 10th highest in the world. As Table 3.4 demonstrates, a clear divide existed between the top three powers and the rest.

Table 3.4: 1982 CINC Top 5[21]

Country	Rank	CINC	T5 Prop.
USSR	1	17.3%	33.0%
US	2	12.8%	24.5%
China	3	11.7%	22.4%
India	4	5.4%	10.3%
Japan	5	5.2%	9.9%

The CINC reveals that India's population of one billion people affords it a major resource of power, but this power is limited by widespread poverty and underdevelopment. Despite having the second largest population in the world, its 10th place economic rank gives it one of the lowest per capita incomes in the world. Major economic and political reform would be needed to maximize its national capabilities.

Supply Variables

Low financial resources, low human capital, and counterproductive policies corresponded to low military industrial capacity during this period. Despite improving economic conditions in the 1970s, GDP averaged just $211 billion between 1980 and 1984. As a result, a limited defense

[21] David J. Singer, Stuart Bremer, and John Stuckey. "Capability Distribution, Uncertainty, and Major Power War, 1820-1965." in Bruce Russett ed., *Peace, War, and Numbers* (Beverly Hills, CA: Sage, 1972), pp. 19-48.

budget of $12 billion (average) posed major restrictions to military modernization. What was allocated for capital expenditure was spent on European fighter aircraft, leaving the Army and Navy short-changed. But the lack of economic resources was indicative of the nature and structure of the economy as a whole, which remained largely agricultural and low-end manufacturing. During this period, high-technology exports (as % of manufactured exports) averaged 3.5 percent, far behind most industrial economies. Japan's high-technology exports, for example, averaged 20 percent during the same time period.[22]

The limitation of economic resources extended into the realm of R&D as well. R&D investment averaged $180 million during this period which only rose marginally from 1 percent of the defense budget in the 1960s to 3 percent by this period.[23] Comparatively, the US and many Western states appropriated 10 percent of their total defense expenditure to R&D. Furthermore, Indian R&D investment was concentrated in the areas of nuclear weapons and ballistic missile technology.[24] In fiscal year 1976-1977, the Department of Atomic Energy accounted for 23% of R&D versus 21% for DRDO.[25] This pattern reflected India's inability to move beyond the licensed manufacturing of Western arms and failures of the "indigenous" Ajeet jet and the HF-24 Marut fighter-bomber programs.[26]

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[22] World Development Indicators, The World Bank, accessed December 2020.

[23] Cohen and Dasgupta, *Arming Without Aiming*, p. 239.

[24] This trend is common among developing states, including China, which strive to fully develop nuclear deterrents before expanding conventional capabilities.

[25] Ahmad, "Science and Technology in India," p. 39.

[26] Both programs were descendants of the British Gnat fighter. These programs were more developmental than strategic since only 147 Maruts and 89 Ajeets were produced. In addition, they were tactically obsolete by 1980 due to major advancements in aircraft technology and countermeasures (the leap from third generation fighter aircraft to fourth was significant).

Similar to R&D, India's approach to developing human capital was underfunded and concentrated in particular areas such as the nuclear program, thus corresponding to low human capital. In the late 1960s India implemented a series of education reforms but by 1980 those reforms had yet to achieve expanding access to higher education. In 1982, only 5 percent of eligible young adults were enrolled in tertiary education. By comparison, tertiary enrollment in Brazil and Japan were 10.7 percent and 30 percent, respectively. Furthermore, only 31.6 percent of eligible students were enrolled in secondary education. Despite these figures, India was estimated to have the third largest stock of "qualified manpower" in the world.[27] Tertiary funding reached its peak in 1982, accounting for 29 percent of total public expenditure in education.[28] It is also estimated that India lost 20 percent of its aerospace employees in the 1980s to emigration to Western states.[29]

Finally, government policies discouraged investment in developing military industrial capacity. Prime Minister Gandhi and the Congress Party supported a shift in procurement policy towards greater military self-reliance by reversing India's dependence on arms imports. This shift was aided by subsequent policies discouraging foreign and private investment in the arms industry. Arms research and production remained publicly funded and centralized within the DRDO and DPSUs. Private industries were discouraged from participating in arms programs. In

[27] Ahmad, "Science and Technology in India," p. 38.

[28] These opportunities, however, were disproportionately filled by the upper middle class. In 1980-1981, less than 5,000 colleges and universities existed despite concerted efforts to expand access. Gretchen Rhines Cheney, Betsy Brown Ruzzi, and Karthik Muralidharan, "A Profile of the Indian Education System," National Center on Education and the Economy (November, 2005), p. 13; and Ved Prakash, "Trends in Growth and Financing of Higher Education in India," *Economic and Political Weekly*, August 4, 2007, pp. 32-50.

[29] S. Laxman, "DRDO gives aeronautics a massive boost," *Times of India*, October 9, 1990; cited in Smith, *India's Ad Hoc Arsenal*, p. 163.

addition, foreign arms producing companies were restricted from investing in India's industry. Finally, science and technology policy refrained from 'excessive' investments in R&D due to the high risks and low return.[30] Conversely, policies that promoted employment (manufacturing) were favored over those that imported advanced technology.

India experienced high availability of foreign supply due to close relations with the Soviet Union, France, Germany, and UK. The Soviet Union, however, maintained an 80 percent share of India's arms imports. Increased arms trade with European states fueled Soviet competition. By 1980 the Soviet Union was offering nearly every conventional weapon system, in many cases before offering them to Warsaw Pact members. As a result, the increased competition empowered India to negotiate for even more favorable preconditions, including co-production of MWS. Despite access to multiple suppliers, India faced complications as a result of its position in the non-aligned movement. Many acquisitions ran into stipulations outlined by the Coordinating Committee for Multilateral Export Controls (the predecessor to the Wassenaar Arrangement) which regulated and embargoed many dual-use technologies. Furthermore, India's critical posture towards the West periodically boiled over on the international stage as it did in the now infamous "Enterprise intervention" in 1971.[31]

To summarize, the combination of high military obsolescence and high security threat environment contributed to high demand for military modernization. As noted earlier, India's competition vis-à-vis Pakistan drove many modernization decisions. In particular, Pakistan's purchase of the US F-16 fighter aircraft, considered one of the most advanced interceptors at the time, challenged the regional balance of power on a qualitative scale. This likely contributed to

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[30] Thomas, *Indian Security Policy*, pp. 238-39

[31] The US sent the USS Enterprise carrier group into the Bay of Bengal as an overt message to the Indian government in the 1971 Indo-Pakistani War. For more on the ramifications of this episode see Cohen and Dasgupta, *Arming Without Aiming*, pp. 75-76, 89.

India's decision to purchase the French Mirage-2000 fighter aircraft as well as MiG-23/27s from the Soviet Union. As a result, India's intense security competition with Pakistan reinforced reliance on state-of-the-art foreign arms, at the cost of improving its own military industrial capacity, despite stated goals of self-sufficiency. At the same time, low military industrial capacity and high foreign supply resulted in moderate arms supply. India's military industrial complex was decidedly unable to match the quality and capabilities of Western and Soviet weapons. Coupled with the MoD's preference for Western and Soviet arms, broad access to foreign arms influenced procurement decisions for stopgaps and qualitative parity. Under these conditions, military modernization was moderate and close to high (with a projected estimated value of about $17 billion for this period).

3.3 PERIOD 2: 1985-1989

3.3.1 Developments in Military Modernization

Table 3.5: Indian MWS, Period 2

Designation	Category	Supplier	Year	Quantity	Projected Estimated Value
Delhi-class	Destroyer	Indigenous	1985	3	$1,800
Sea Harrier	Fighter	UK	1985	10	$466
Charlie-I	Submarine	USSR	1985	1	$550
Mi-26	Helicopter	USSR	1985	10	$223
Sea Harrier	Fighter	UK	1986	8	$497
MiG-29	Fighter	USSR	1986	70	$1,600
INS Viraat	Aircraft Carrier	UK	1986	1	$147
Mi-24/35	Helicopter	USSR	1988	20	$317
Total:					**$5,500**

By 1985, Rajiv Gandhi consolidated control in the Indian Parliament after the Congress Party achieved landslide victories in elections at the end of 1984. India continued to pursue aggressive security policies and investment in military modernization. Military expenditure and investment in R&D expanded steadily. In 1987, India officially intervened in the Sri Lankan civil war by introducing an Indian Peacekeeping Force as negotiated by the Indo-Sri Lanka Peace Accord, despite its prior history of supporting the Tamil rebels. During this same time the Brasstacks military exercises nearly instigated another war with Pakistan. These actions were followed by increased insurgency in Kashmir that picked up in 1989. The military also stepped up anti-China exercises and positions in order to enhance leverage in the ongoing border dispute. In 1989, Prime Minister Gandhi and the Congress Party were defeated in elections following the fallout of the Bofors Howitzer scandal.

In light of these conditions, India's military modernization in this period consisted of four key developments: fighter aircraft, aircraft carrier capabilities, naval destroyers, and nuclear submarines.

In the area of fighter aircraft, in 1986, India augmented its earlier 1982 contract for Mig-29s so that it procured about 70 such aircraft, which were delivered from 1984-1988. The MiG-29 was considered state-of-the-art having just been introduced into the Soviet air force in 1983. Despite being the designated challenger to American F-15s and F-16s, the MiG-29 suffered from inherent engine flaws. The Klimov RD-33 engines frequently saw premature failure in two-thirds of the engines supplied.[32] Due to the constant overhauling and reduced operations tempo of the aircraft, its lifespan was cut in half from 800 hours to 400 hours.

India procured the INS Viraat (HMS Hermes), a Centaur-class aircraft carrier, from Great Britain in 1986. (The HMS Hermes was the last Centaur-class aircraft carrier built by the Royal Navy; it entered service in 1959 and was decommissioned by the Royal Navy in the early 1980s). India purchased the carrier in 1986 for $147 million along with upgrades in electronics

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[32] "The German Luftwaffe MiG-29 Experience," *Fighter Tactics Academy*, accessed June 2014.

and radar. The vessel was commissioned in the Indian navy in 1987.[33] The INS Viraat operated a small squadron of Sea Harriers which India acquired in period 1.

India began construction of the first of three indigenous Delhi-class destroyers in the mid-1980s at Mazagon Docks Limited in Mumbai, with the first keel laid down in 1987.[34] The destroyers represented the largest indigenous MWS project undertaken at the time and incorporated design elements from both the Soviet Sovremenny class and Kashin-II class.

India signed a lease for a Charlie-I class nuclear submarine from Russia in 1985. It was officially commissioned in 1988 as the INS Chakra. Leased for three years, the Chakra was intended to be a pivotal training platform for future expansion nuclear propulsion. The Chakra, however, faced constant mechanical problems, including the propulsion system.[35] Due to the plague of problems, the MoD opted not to renew the Chakras lease in 1991 and subsequently returned it to Russia.

Among other capabilities, India obtained four Mi-26 heavy transport helicopters between 1986 and 1989.[36]

Overall, this period saw continued military modernization despite the volatile political climate in India. Following his mother's assassination, Rajiv Gandhi took over as prime minister in 1984. He immediately ordered General Krishnaswami Sundarji, chief of the army, to

[33] At the time that the ship was retired, Indian officers noted a somewhat higher buying price of $465 million that possibly included some upgrades and equipment: see "INS Viraat: Bought for USD 465 million, world's oldest warship is value for money," *India Today*, Feb 27, 2017.

[34] Eventually, these took over a decade to complete and enter service, as the vessels were launched for trials in the early 1990s and then commissioned in 1997-2001.

[35] The Soviet Union decommissioned all of their Charlie-I submarines after 1990.

[36] *The Military Balance* (IISS) initially indicated that India had ten Mi-26 helicopters but later changed the figure to four. Indian press reports usually mention that four such helicopters were operational from the late 1980s through the 2000s, with one crashing in 2010 and the remaining three phased out in the early 2010s.

implement a major military modernization plan.[37] While the nearly $6 billion (projected estimated value) in MWS procurement in period 2 is less than in period 1, the arms packages plugged critical holes in the military's force structure. Most of the MWS procured, however, were extensions of prior contracts.

3.3.2 Factors Contributing to Military Modernization

India's military modernization in 1985-1989 corresponded with key aspects of its military industrial capacity, foreign supply, military obsolescence, and changes in the security threat environment.

Demand Variables

India's military obsolescence this period was moderate due to major shortfalls in the IAF and the navy's force structure but improved over Period 1 following several MWS procurements. First, despite designating the navy an area of significant need for modernization, India's total principal surface combatants declined from 30 in period 1 to 27 in period 2. The addition of one aircraft carrier and five destroyers was offset by the decommissioning of nine frigates. Furthermore, the carrier INS Vikrant became decreasingly operational due to increasing maintenance issues and tactically limited to launching Sea Harriers. Earlier refits in 1979-1983 failed to extend the carrier's capabilities to service fourth-generation aircraft or prolong its steam power-plant. Second, India extended its overall combat aircraft capabilities from 630 aircraft in 1980 to 833 in 1989. However, over one-third (20 squadrons) of the IAF's fighters/FGAs consisted of MiG-21 aircraft which first entered service in India in 1964. The initial MiG-21 squadrons would face decommissioning in the early 1990s.

[37] Cohen and Dasgupta, *Arming Without Aiming*, pp. 10-11.

The security threat environment was moderate following improvements in regional stability. Four factors contributed to this threat level. First, the Soviet Union withdrew from Afghanistan in 1988 and one year later abdicated control over the Soviet republics. Second, US-Pakistani relations soured following the death of General Muhammad Zia-ul-Haq and the US Ambassador to Pakistan, Arnold Lewis Raphel, in a mysterious plane crash. The US also began to raise concerns over Pakistan's support for militant incursions into Indian controlled territory in Kashmir. As a result of the incursions, regular Indian military exercises in the region raised the specter of escalation. These fears were further compounded by General Krishnaswamy Sundarji, Chief of the Indian army, who organized the massive Brasstacks military exercise in light of the incursions and growing concerns over Pakistan's nuclear weapons program. The Brasstacks military exercise was intended to test the army's capacity to respond on a massive scale but there is speculation about the exercise's true intent.[38] Third, as the US began to distance itself from Pakistan, China began to strengthen its ties through increased arms sales, including HQ-2 surface-to-air-missiles (SAMs), to counter India's latest acquisitions. Finally, China's crackdown on democratic activists in Tiananmen Square prompted swift international condemnation from the United Nations and many Western states. The crises resulted in a Western arms and technology embargo and began to signal fears of growing militarism within the CCP.

As Table 3.6 demonstrates, India's position relative to national capabilities remained unchanged.[39]

[38] The exercise quickly turned into a full-blown crisis. The exercise was an updated variant of the German Schlieffen Plan and was considered the largest land army maneuver since World War II. See Cohen and Dasgupta, *Arming Without Aiming*, pp. 55-57.

[39] The only exception is India's position vis-à-vis China, which shrunk 1.4 percent. This is primarily a result of declining military expenditure in China during this period.

Table 3.6: 1987 CINC Top 5			
Country	**Rank**	**CINC**	**T5 Prop.**
USSR	1	17.3%	33.0%
US	2	13.4%	25.5%
China	3	11.2%	21.2%
India	4	5.8%	11.0%
Japan	5	4.9%	9.3%

A clear gap between the top three powers and the rest continued to put India at a strategic disadvantage.

Supply Variables

Despite improvements in military expenditure and strong economic growth, India continued to experience low military industrial capacity due to low human capital and inadequate defense policies. Positive economic growth provided some increased funding for military expenditure and other development programs. The economy grew at an average pace of 5.9 percent with GDP averaging $282 billion for the period. Despite the positive growth, high-technology exports (as % of manufactured exports) remained constant at 3.8 percent, indicating little growth in the advanced sectors of the economy.[40] Average military expenditure grew to $16.3 billion, an increase of 29 percent over the prior period.

Changes in R&D were more positive. R&D expenditure grew 150 percent from 1985 to 1989 to $247 million. The strategic weapons program continued to benefit the most from these resources, but the changes reflect a renewed emphasis on building indigenous MWS. In particular, the MoD identified the development of a light combat aircraft (LCA/Tejas), an advanced light helicopter (ALH/HAL Dhruv), main battle tank (MBT/Arjun), and the Integrated Guided Missile Development Program (IGMDP) as critical to Indian military modernization.

[40] World Development Indicators, The World Bank, accessed November 2020.

Each of these programs, excluding the tank program, was initiated in Period 1 and each program represented a major undertaking by the DRDO, which to date had not successfully developed an indigenous MWS.[41] At this time, India continued to leverage manufacturing under foreign licenses and limited coproduction.

Human capital development during this period remained low. The government's education programs remained concentrated towards expanding access to primary and secondary schools and reducing the state's high illiteracy rate, which exceeded 50 percent in 1991 (earliest year for which data is available) and disproportionately affected women.[42] As a result, investment in tertiary education remained concentrated in the state technical universities. This distinction is demonstrated in the national enrollment rates where secondary education rose five points to 36.7 percent while tertiary rose only one point to 6 percent by 1987.[43] As a result, an undereducated talent pool posed serious limitations to India's high-technology sector and military industrial complex.

During this period there were two significant policy reforms related to military modernization. First, under Prime Minister Rajiv Gandhi, India somewhat shifted from the post-1962-war strategic emphasis on China to Pakistan. Rajiv Gandhi ultimately decided to work with China via diplomatic means, rather than focus on it as a strategic rival. Second, Army Chief General Krishnaswamy Sundarji shifted from the policy of strategic restraint and instead advocated an aggressive strategy of pre-emption and mobile-strike capabilities. As a result, he

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[41] The LCA and ALH were eventually built in India but received considerable foreign design and production input such as an imported engine.

[42] UNESCO Institute for Statistics, United Nations Educational, Scientific and Cultural Organization, "Adult and Youth Literacy: National, regional, and global trends 1985-2015," (Montreal, Quebec: UNESCO, June 2013), p. 50.

[43] *World Bank*, World Development Indicators.

shifted the Army's weapons procurement towards mechanized forces, modern artillery, and air assault. This shift was a direct response to Pakistan's maturing nuclear weapons program. General Sundarji perceived the need to strike quickly into the heart of Pakistan in a future conflict. Thus, the shift towards quick rearmament favored foreign acquisition.

India's availability of foreign suppliers dropped to moderate this period due to its import-substitution policies and overreliance on Soviet arms. Domestic policies continued to deter foreign investment and promote employment-oriented policies. The Soviet Union also remained the primary supplier of MWS, representing over 70% of total arms imports. In the 5-6 years since policymakers set out to reverse the ratio of arms imports through import-substitution there were little results to showcase.

At the same time, the armed forces struggled to mitigate block obsolescence. India started producing the MiG-21 under license in 1962 continuing production until 1985. By that time over 900 MiGs had been produced with the earliest blocks facing obsolescence. In addition, the armed services were retiring several other weapons systems at exponential rates. These MWS included Marut, Hunter, Canberra B-8, Vampire NF-10, Gnats, and Su-7BMK fighter/bomber aircraft. Therefore, military obsolescence accounted for the high rate of aircraft procurement during this period.

To summarize, the combination of moderate military obsolescence and moderate security threat environment contributed to moderate demand for military modernization. India's purchase of the INS Viraat from the UK and the leasing of the Charlie-1 nuclear submarine also demonstrated India's plans for expanding power projection and strategic standoff capabilities against Pakistan. But these procurements were foreign rather than domestic because of India's low military industrial capacity, which was at the time incapable of producing such complex

MWS. Under these conditions, military modernization was low (with a projected estimated value of just under $6 billion for this period).

3.4 PERIOD 3: 1990-1994

3.4.1 Developments in Military Modernization

Table 3.7: Indian MWS, Period 3

Designation	Category	Supplier	Year	Quantity	Projected Estimated Value
T-72 M1	Tank	Russia (L)	1990	130	$900
Jaguar-S	Attack Aircraft	UK (L)	1993	15	$374
Mi-24	Helicopter	Kyrgyzstan	1994	15	$302
Total:*					**$1,500**

* Total rounded to nearest 500
(L): Units built under license or with foreign kits

By 1990, the Soviet Union began to collapse and tensions with Pakistan remained elevated. By now, the Kashmir dispute was linked to nuclear weapons. The demise of the Soviet Union rendered active arms agreements uncertain along with supplies for spare parts. Rapprochement with the US was inhibited by increased US concerns over nonproliferation issues. The US was also preparing for war against Saddam Hussein. In 1991, fiscal imbalances combined with high debt, severe currency devaluation, and low foreign investment, resulted in a major financial crisis. At the time, India's accumulated debt totaled $7.4 billion.[44] The crisis prompted major financial reforms and intervention by the International Monetary Fund (IMF) and World Bank. During that same year, former Prime Minister Rajiv Gandhi was assassinated by Tamil Tiger rebels.

While limited, India's military modernization throughout this period consisted of some advancements in tanks, fighter aircraft, and attack helicopters.

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[44] International Financial Statistics Database, *International Monetary Fund*, accessed April 24, 2013.

India signed an agreement with Russia to domestically produce 130 units of the upgraded T-72 M1 tank from kits supplied by Russia as a supplemental order to those purchased initially in 1979. The T-72 was the successor to the domestically manufactured Vijayanta which ceased production in the mid-1980s. The M1 variant possessed improved reactive armor plating, guided anti-tank missile capabilities, and the more powerful V-84 engine.

India ordered additional units of the Anglo-French SEPECAT Jaguar-S. This included upgraded navigation and fire-control systems, paralleling the advancements in technology during the 1980s. The Jaguar had also been adapted to carry out nuclear strike missions.[45]

Some reports suggest India ordered about 15 Mi-24s from Kyrgyzstan in 1994, all surplus helicopters, many from the Afghanistan war, though the status of this order is unclear (the IAF then had about 30 Mi-24s, most stationed in the Western Air Command near New Delhi).

Despite a decline in major arms acquisition compared to prior periods, the structure of the Indian armed forces changed significantly compared to 1980. By 1990, the Indian armed forces grew to almost 1.3 million personnel and a budget of $17.6 billion, an increase of 48 percent in defense spending over the decade.[46] The army absorbed 200,000 additional personnel with the biggest expansion in capabilities consisting of 1,200 T-72 and Vijayanta tanks.

The Indian navy on the other hand grew by only a few thousand extra personnel and the number of principal surface combatants declined from 30 to 27. Despite these observations, the nature of Indian naval force structure noticeably changed. The submarine fleet grew from eight combatants to 18, not including the leased INS Chakra. Likewise, the acquisition of the aircraft carrier INS Viraat gave the navy a major boost in power projection. In the prior two periods,

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[45] Ashley J. Tellis, *Strategic Asia* (2001), p. 533.

[46] IISS, *The Military Balance, 1990-1991*, pp. 160-162.

India decommissioned nine frigates while also acquiring five Kashin destroyers from the Soviet Union.

The nature of the IAF also changed markedly. Despite a small decline in personnel, IAF capabilities grew to over 800 combat aircraft with nine different principal aircraft instead of five. In addition, the MoD's choice not to renew its lease on the Soviet Charlie-I nuclear submarine in 1991 meant suspending 'active' research and training on nuclear submarines.

3.4.2 Factors Contributing to Military Modernization

India's military modernization in 1990-1994 was influenced by its military industrial capacity, foreign supply, military obsolescence, and changes in the security threat environment.

Demand Variables

Military obsolescence was moderate during this period for four reasons. First, 20 squadrons of MiG-21 fighters were to begin decommissioning in 1994-1995. The LCA was intended to replace the MiGs but the indigenous aircraft would not become operational for over a decade. The delays in the LCA program would ultimately force the IAF to restrict flying hours and possibly pursue extensive refits of several MiG squadrons to extend their service lives. Second, the carrier INS Vikrant became inoperable by 1994, with decommissioning imminent. The loss of the Vikrant cut the navy's carrier operations in half. Third, the navy faced the imminent obsolescence of its seven Kalvari class attack submarines, with little prospect for modernization. The first four of the Soviet-built diesel-electric submarines were commissioned between 1967 and 1969. Finally, the Persian Gulf War demonstrated that the state-of-the-art in military technology had changed. The conflict forced defense planners to re-evaluate arms requirements and specifications, further delaying MWS programs.

The regional security threat environment was low during this period for three reasons. First, the collapse of the Soviet Union relegated the Communist threat in South Asia. The withdrawal of Soviet forces from Afghanistan left a political vacuum in the country resulting in civil war, consequently pre-occupying Pakistani defense and intelligence services. Second, the US stopped providing military aid to Pakistan as a result of an expanding rift in relations due to its unstable leadership, support for militant insurgencies in India, and advancing nuclear program. Third, arms and technology embargoes placed against China following the Tiananmen Square crisis helped to minimize concerns about Chinese militarism. Thus, India's two rivals faced domestic challenges decreasing the regional threat environment.

Furthermore, the collapse of the Soviet Union had a profound impact on the international distribution of power, as Table 3.8 demonstrates.

Table 3.8: 1992 CINC Top 5

Country	Rank	CINC	T5 Prop.
US	1	14.8%	32.5%
China	2	12.4%	27.1%
Russia	3	6.7%	14.7%
India	4	6.3%	13.9%
Japan	5	5.4%	11.9%

Russia's CINC score fell to 6.7 percent from 17. 3 percent in 1982 and its T5-Prop score split in half. Likewise, China rose to claim the second spot. Its CINC remained unchanged from 1982 but its share of the top five grew marginally.

Supply Variables

Economic crisis had a detrimental impact on military industrial capacity during this period, thus constraining it to a low level. Economic liberalization produced fluctuations in hard currency and the state incurred high debt after draining currency reserves. In addition, devaluation of the rupee limited overseas buying power. As a result, the economy contracted from $350 billion in 1990 to $246 billion in 1993. The defense budget contracted but managed to average $17 billion for the period. Compounding its inability to make debt payments was a 60 percent decline in trade with Russia (from $2.3 billion in 1990/91 to only $800 million in 1993/94).[47] Furthermore, the structure of the economy remained unchanged from Period 2 despite economic liberalization. For example, high-technology exports (as % of manufactured exports) averaged 4.7 percent, an increase of less than one percent from Period 2.[48]

R&D was hit hard by the economic crisis, contracting by as much as 40 percent in 1992. R&D expenditure averaged $307 million for the period. As a percentage of the total defense budget, R&D expenditure declined from a high of three percent in Period 2 to 1.8 percent. This timing was unfortunate considering several MWS programs were nearing maturation. The cutbacks led to hundreds of layoffs of talented technicians and engineers throughout the DRDO and ordnance factories. This pattern of stagnation extended into education. Despite reaching 5.8 percent in 1990, tertiary enrollment failed to eclipse 6 percent during this period.

During this period there were no significant policy reforms affecting military modernization. The emphasis on mechanized re-armament subsided following Period 2, and as a result, defense planners returned to developing indigenous MWS.

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[47] Singh, *Arms Procurement Decision Making*, p. 64.

[48] *World Bank*, World Development Indicators, accessed November 2020.

Combined, these indicators reveal that military industrial capacity was low for this period thus constraining India's ability to indigenously modernize its military.

Foreign supply was moderate this period as the collapse of the Soviet Union significantly disrupted India's MWS supply. During the 1980s, India imported 75 percent of its arms from the Soviet Union, including spare parts and training of support personnel. The Soviet void magnified India's dependency problem and handicapped the military's training and maintenance.[49] Several major arms manufacturers and suppliers were now located in former Soviet republics with their future operational status and contractual obligations uncertain. The collapse forced Indian defense planners to negotiate directly with former republics and the factories within them for spare parts. Likewise, Russia and other states began demanding hard currency in exchange for weapons, rather than soft currency which favored India in prior transfers.[50] Coupled with the rupee's instability, arms transfers with Russia and the former Soviet republics were hampered throughout this period.

To summarize, the combination of moderate military obsolescence and low security threat environment contributed to low demand for military modernization. However, this assessment understates the dramatic impact that foreign and domestic events had on military modernization. The collapse of the Soviet Union, India's largest arms supplier, significantly disrupted arms transfers and likely complicated active agreements that were never completed. At the same time, tensions with Pakistan remained a concern as its nuclear weapons program

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[49] Ravinder Pal Singh, ed., *Arms Procurement Decision Making Volume I: China, India, Israel, Japan, South Korea and Thailand* (New York: Oxford University Press for SIPRI, 1998), p. 64.

[50] These explanations are insufficient to describe the drop in Indian arms procurement from Russia for three reasons. First, India possessed a substantial reserve of hard currency prior to the financial crisis which was used to plug other sectors of the national budget instead of finance arms procurement. Second, the Soviet Union's collapse did not prevent other states from acquiring surplus Soviet equipment, most notably China. Third, given the close relationship between Indian and Soviet arms developers beforehand, India could have taken greater advantage of the exodus of Russian scientists in the following years.

progressed and conflicts in Kashmir continued. Likewise, India was afflicted by a domestic crisis as the economy faltered due to high debt, fiscal imbalances, and currency devaluation. As a result, resources for military modernization, let alone investment in military industrial capacity, were limited. Thus, low military industrial capacity and moderate foreign supply resulted in low-moderate arms supply. Under these conditions, military modernization was low (with a projected estimated value of $1.5 billion for this period).

3.5 PERIOD 4: 1995-1999

3.5.1 Developments in Military Modernization

Table 3.9: Indian MWS, Period 4					
Designation	Category	Supplier	Year	Quantity	Projected Estimated Value
MiG-21PFM	Fighter Aircraft	Russia	1995	11	$88
Leander-class	Frigate -Training	UK	1995	1	$30
Su-30 MK	Fighter Aircraft	Russia	1996	40	$1,700
MiG-21UM	Trainer Aircraft	Ukraine	1996	8	$64
Kilo-class	Submarine	Russia	1997	2	$500
Talwar-class	Frigate	Russia	1997	3	$850
Harrier	Fighter Aircraft	UK	1997	2	$24
Su-30 MKI	Fighter Aircraft	Russia	1998	10	$380
TS-11 Iskra	Trainer Aircraft	Poland	1999	20	$9
Jaguar-S	Attack Aircraft	UK (L)	1999	17	$454
Mig-21 upgrade	Fighter	Russia	1996		$600
Total:*					**$4,500**

* Total rounded to nearest 500

The Indian economy bounced back by 1994 and military arms supplies with Russia began to return to pre-1990 levels. Relations with China also improved despite no settlement over their borders. President Jiang Zemin even made the first Chinese head of state visit to India in 1997. But in March 1998 the conservative oriented Bharatiya Janata Party (BJP) rose to power in the Indian Parliament. The BJP immediately advocated for a demonstration of India's nuclear capabilities and to become an open nuclear power. The five nuclear detonations staged (Pokhran-

II) in May 1998 set off an international crisis and equivalent response from Pakistan. Many states including the US, China, Japan, and United Nations condemned the provocation, but only the US and Japan imposed economic sanctions that also affected aid to India from multilateral development banks. Subsequently, in 1999, there was a limited war between Pakistan and India in the Kargil region of Kashmir.

Subsequently, India's military modernization this period consisted of key developments in fighter aircraft, attack submarines, naval frigates, and trainer aircraft. India acquired additional units of the MiG-21 and Jaguar-S from Russia and Britain-France, respectively. In addition, India also procured Russia's newest fourth-generation fighter, the Su-30 MKI. This was a significant upgrade and coincided with the new Air Power Doctrine, a project prompted by the results of air power in the Gulf War, which advocated for greater offensive air operations. The Su-30 MKK was developed as a result of a request for tender between Russia and China which called for a more advanced adaptation of the Su-27 multirole fighter. The Indian Su-30 MKI was the second variant of the aircraft with more advanced avionics and electronic warfare systems. The early cooperation ultimately evolved into a licensed production deal for India as well.

During this period, India procured two additional Kilo-class diesel-electric attack submarines from Russia. The purchase gave the navy a total of ten Kilos and offset the first Foxtrot deactivations. India also ordered three Talwar-class frigates from Russia in 1997 (they were eventually delivered and commissioned in the early 2000s) and commissioned one British Leander-class frigate as a training ship. Despite the purchases, India's frigate fleet would decline from 17 combatants to 12 from 1995-1999 due to several Leander-class decommissions.

In terms of trainer aircraft, India procured a combined 28 TS-11 Iskras and MiG-21UMs from Poland and Russia, respectively. By 1995, India had been attempting to transform the indigenous Marut fighter into a trainer aircraft, an already technologically obsolete program that had fallen behind schedule. As a result, procurement of the MiG-21 UM, Iskra, and Harrier trainers were stopgap purchases necessary to fulfill a critical shortfall in capabilities. The MoD also began shopping for a longer-term solution to the trainer problem as the indigenous program was showing few signs of progress. Furthermore, due to delays in the LCA program and following successful upgrades in Russia, the MoD approved a plan to modernize 125 MiG-21s for $626 million.[51]

Overall, arms procurement during this period was relatively balanced and took greater advantage of surplus Russian arms. This was also reflected in defense spending which grew by 36%, topping out at $25 billion by the end of the decade.

3.5.2 Factors Contributing to Military Modernization

India's military modernization in 1995-1999 corresponded with developments in military industrial capacity, foreign supply, military obsolescence, and changes in the security threat environment.

Demand Variables

During 1995-1999 India continued to face moderate military obsolescence due to block obsolescence and technological obsolescence. Block obsolescence affected the air force the most which suffered from delays in the LCA program and the imminent deactivation of its entire MiG-21 fleet. By 1995, the IAF's MiG-21 fleet was reduced from 20 squadrons to 17 and the purchase of 11 used MiG-21s from Russia served as a stopgap for further reductions.

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[51] Jagan Pillarisetti, "The MiG-21 Bison Upgrade Programme," *Bharat Rakshak*, November 25, 2009.

The Indian navy also faced substantial block obsolescence. In January 1997, the INS Vikrant was decommissioned leaving India with only one operational aircraft carrier.[52] During this period the Indian navy also began the process of decommissioning its eight Kalvari-class attack submarines beginning in 1996 and to be completed by 2010.

Finally, India's ability to keep pace with the state-of-the-art in military technology continued to lag behind the US, Europe, and Russia. For example, the backbone of the air force remained the MiG-21, now more than three decades old and incapable of meeting modern battlespace requirements including ground support. The Indian military was partially able to augment this weakness through foreign acquisitions such as the Su-30. As a result of these developments, military obsolescence rose to moderate levels having an adverse effect on military modernization.

The security threat environment during 1995-1999 was high due to increased regional instability vis-à-vis Pakistan and increases in India's national capabilities. The Pokhran-II nuclear tests conducted in May 1998 had severe destabilizing effects across the region thus inviting international condemnation. Pakistan responded vehemently with six nuclear tests of its own two weeks later, prompting global fears of nuclear war between the two states. The tensions spilled over into 1999 when Pakistani militants seized high-mountain outposts vacated by the Indian army in the winter months in the Kargil region. Tensions with Pakistan were further compounded by Pakistan's growing military-military relationship with China. Chinese arms transfers to Pakistan rose during this period and included F-7 fighter aircraft, LY-60 SAMs, and C-802 anti-ship missiles, each designed to counter India's air and naval superiority. Together, these developments revealed that India could no longer count on quantitative military superiority

[52] At this time, India began negotiating with Russia for the purchase of the Admiral Gorshkov, which was deactivated in 1996. See Cohen and Dasgupta, *Arming Without Aiming*, p. 90.

in the face of Pakistani nuclear weapons. In addition, the ensuing arms race and US censure drove Sino-Pakistani cooperation closer together. Finally, India's relative standing as a major power shifted favorably due to an improving economy and economic recession in Russia and Japan. As Table 3.10 demonstrates, India possessed the third highest share of national capabilities, behind only China and the US.

Table 3.10: 1997 CINC Top 5

Country	**Rank**	**CINC**	**T5 Prop.**
US	1	14.9%	32.3%
China	2	14.0%	30.2%
India	3	6.6%	14.3%
Russia	4	5.6%	12.1%
Japan	5	5.1%	11.1%

As a result of this shift in global capabilities, India possessed a window of opportunity to enhance its standing as a major power in the international community. This, along with a high security threat environment encouraged investment in military modernization.

Supply Variables

Military industrial capacity during 1995-1999 was low for four reasons: (1) improved but unstable financial resources, (2) low human capital, (3) low R&D, and (4) ineffective government policies. Despite lingering effects from the financial crisis in 1991, military expenditure rose 36.6 percent, outpacing economic growth for the period.[53] Lower FDI and an unstable currency, however, mitigated the gains of increased military expenditure. In 1997, GDP reached $423 billion, signaling that India had overcome many of the setbacks of the prior

[53] The nature of India's economy also changed little during this period. High-technology exports (as % of manufactured exports) remained low at 6.1 percent (average) for the period, compared to 26.3 percent in Japan. This observation reveals that India's military industrial complex lacked many of the national resources necessary to produce state-of-the-art weaponry. *World Bank*, World Development Indicators, accessed September, 2013.

financial crisis. Likewise, high-technology exports (as % of manufactured exports) rose 2 percent to 6.5 in 1997. Much of this gain is attributed to India's growing information technology sector. Human capital indicators continued to remain low thus limiting the talent pool from which to draw engineers and technicians for arms programs. Tertiary enrollment rose less than 1 percent between 1990 and 1997. At 6.4 percent in 1997, India's tertiary enrollment remained far behind the 49 percent average of developed states.[54] Conversely, R&D averaged $446 million for the period, a 45.3 percent increase from Period 3. Despite the sizeable increase, R&D constituted only 2.1 percent of the total defense budget. This figure was insufficient to cover the breadth of India's military modernization goals. Furthermore, the Indian military industrial complex spent much of the period correcting the setbacks and personnel cuts in Period 3. Finally, Indian policymakers continued to favor a counterproductive approach to military modernization. Indian arms procurement policies continued to prioritize indigenous arms development over foreign arms procurement. Procurement policies further dis-incentivized opportunities to absorb foreign technology through partnerships and diversification of suppliers. As Table 3.7 above demonstrates, foreign arms transfers continued to be dominated by Russia.

Foreign supply this period was low-moderate due to resurgence in Russian arms exports and economic sanctions imposed by the US. The resurgence of the Russian arms industry was a positive trend for India. Russia continued to supply over 70 percent of India's MWS and a 90 percent share of all foreign arms imports. The economic sanctions, however, further isolated India from Western arms and technology. The sanctions were a response to the nuclear tests at Pokhran-II and subsequent nuclear standoff with Pakistan. Aside from aircraft engines, the US was not a significant arms supplier to India, but the sanctions came at an unfortunate time when

[54] *World Bank,* World Development Indicators, accessed November 2020.

the Western arms industry was downsizing and globalizing its operations.[55] The US was also able to leverage its position as a global leader and discourage other states from transferring arms and technology to India, notably the UK and Israel. The sanctions also ceased credit guarantees and required the opposition of lending by international financial institutions to India, which had borrowed $1.5 billion from the World Bank in 1997. This limitation further constrained India's ability to acquire stable financing for foreign arms imports. Most of the sanctions were rolled back within two years but the Pokhran nuclear tests and standoff with Pakistan had a lingering effect on foreign arms deals. As a result of these developments, India's foreign supply remained low, thus constraining its ability to acquire and absorb foreign arms and technology and promote military modernization.

To summarize, the combination of moderate military obsolescence and a high security threat environment contributed to moderate demand for military modernization. While this period was defined by high-stakes crises and conflict, many of the implications for military modernization were not reflected until later periods. The supply of Russian MWS rebounded but there was no discernable change in the pattern of procurements compared to earlier periods to reflect the international security events noted above. The US and Japan were the only states to enact military embargoes, which did not significantly alter India's available foreign suppliers. Even the UK continued licensing production of the Jaguar-S attack aircraft; however, the crises almost certainly spoiled potential MWS procurements in the latter part of the period from European suppliers. Thus, it is likely, in contrast to earlier periods, that the elevated security threat environment had a negative impact on foreign arms supply. At the same time, low military

[55] The sanctions did jeopardize or delay several arms programs including the LCA which was dependent upon GE F-404 engines from the US. For more on the effects of the 1998 sanctions see "Diplomacy, Sanctions, and the U.S. Nonproliferation Dialogue with India and Pakistan," *Asian Survey* (Sept/Oct 1999).

industrial capacity and low-moderate foreign supply resulted in low arms supply overall. Under these conditions, military modernization was low but greater than the previous period (a projected estimated value of near $5 billion for this period).

3.6 PERIOD 5: 2000-2004

3.6.1 Developments in Military Modernization

Table 3.11: Indian MWS, Period 5

Designation	Category	Supplier	Year	Quantity	Projected Estimated Value
Su-30 MKI	Fighter Aircraft	Russia (L)	2000	140	$5,400
HAL Dhruv	Helicopter	Germany-India	2000	300	$2,100
Mi-17	Helicopter	Russia	2000	40	$170
Arjun MK-1	Tank	Indigenous	2000	120	$300
Mirage-2000	Fighter	France	2000	10	$330
Kolkata-class	Destroyer	Indigenous	2000	3	$2,100
IL-78MK	Tanker Aircraft	Uzbekistan	2001	6	$150
T-90S	Tank	Russia (L)	2001	310	$650
MiG-23UB	Fighter Aircraft	Ukraine	2002	6	$58
MiG-21PFM	Fighter Aircraft	Kyrgyzstan	2003	19	$152
MiG-21UM	Trainer Aircraft	Ukraine	2003	8	$64
Mi-17	Helicopter	Russia	2003	6	$27
Gorshkov	Aircraft Carrier	Russia	2004	1	$2,300
Hawk-132	Trainer Aircraft	UK (L)	2004	66	$2,000
Akula-2	Submarine	Russia	2004	1	$650
Phalcon	AWACs	Israel	2004	3	$1,100
Total:					**$17,500**

(L): Units built under license

Tensions with Pakistan resumed into the new millennium with additional incursions into Kashmir followed by Indian military mobilizations. International perceptions turned, however, in late 2001 following the 9/11 terrorist attacks. US trust and perceptions of Pakistan dropped significantly while the Bush administration made inroads with India. By October 2001, all sanctions were removed. This period also saw a spike in terrorist attacks in India. In December 2001, the Indian Parliament was attacked by terrorists affiliated with Lashkar-e-Taiba and Jaish-e-Mohammed. Additionally, the BJP was defeated in May 2004 in a surprise election result that returned the Congress Party to power.

Subsequently, India's military modernization this period consisted of key developments in fighter aircraft, aerial refueling tankers, tanks, aircraft carrier capabilities, naval destroyers, and nuclear attack submarines.

The IAF achieved two major agreements in fighter aircraft. First, it signed an agreement to produce the Su-30 MKI under license in India with full technology transfer. The agreement included 140 units with the option for more later. Second, the IAF purchased 10 additional French Mirage fighters. The deal would provide the IAF with 45 total Mirage fighters and replace several lost during training accidents.

In terms of other aircraft, India completed an agreement with Great Britain to produce the Hawk jet trainer.[56] By this time, an indigenous jet trainer program was terminated due to technological difficulties. The necessity for an advanced jet trainer, however, was compounded by the alarmingly high accident rate within the IAF as well as a transition for trainees from propeller to high-performance jets.[57] Additionally, India procured 6 IL-78MKs,which are modified Il-76, aircraft built in Uzbekistan. These aerial tankers were the first major platforms of their kind for the IAF giving India a significant boost in its ability to project force beyond the

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[56] Cohen and Dasgupta, *Arming Without Aiming*, p. 85.

[57] See Rupak Chattopadhyay, "The Indian Air Force: Flying into the 21st Century," *Military Technology*, Vol. 26, No. 5 (2002), pp. 42-46.

subcontinent. The addition of the tankers would eventually set the future requirement of all combat aircraft to have mid-air refueling capability.[58] Also, in 2004, India finalized a $1.1 billion deal for three Israeli Phalcon airborne warning and control systems that were placed on Il-76 aircraft, and these were delivered to India's air force in 2009-2011.

In terms of tanks, India began production of the Indigenous Arjun and also procured 310 units of Russia's new T-90S. Even with a reorganization of the armored divisions (from two to three) the balance of capabilities of the Indian army remained relatively unchained excluding a trade for fewer Vijayantas for more T-72 tanks.

In the case of the Arjun, nearly 50 percent of the tank's components are foreign content, including the diesel engine, transmission, gun barrel, and fire control system. There are also serious concerns with the tank's performance as a result of its weight and inadequate armor. This underperformance, in addition to the tank's soaring costs, is reflected in the initial order of only about 120 units (modest in tank terms). The Arjun, conceptualized in the 1970s but hindered by design and development flaws for two decades, finally began entering service with the Indian Army in 2004. (By 2010, about 50 were in service, with all 120 delivered to the Army by the mid-2010s). These problems with the Arjun program ultimately opened the door to license production of the more affordable and capable Russian T-90S tanks which would become the mainstay for the Army's armored divisions.

India ordered the INS Vikramaditya (Admiral Gorshkov), an unfinished Kiev-class 45,000-ton aircraft carrier, from Russia in 2004 for about $800 million (though the price was increased to $2-3 billion in 2009; it was eventually inducted into the Indian Navy in 2014). The $800 million deal included an extensive refit to upgrade the vessel and return it to operational

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[58] "Indian Air Force to have mid-air refueling capability on all combat aircraft," *New Delhi Television*, December 9, 2012.

status. A supplemental arms package worth $1 billion included 12 MiG-29D aircraft, four MiG-29KUB aircraft, six Ka-31 anti-submarine helicopters, and various armaments for the carrier. In terms of naval destroyers, India approved construction of three Kolkata-class (Project-15) guided missile destroyers in 2000. The indigenous destroyers incorporate stealth features in its design as well as advanced land-attack capabilities, including the BrahMos cruise missile. For nuclear attack submarines, India initiated a ten-year lease with Russia for an Akula-II class nuclear attack submarine.[59] Commissioned as the INS Chakra, the submarine was initially intended as a training platform but eventually became part of India's regular submarine fleet.[60]

Total number of personnel remained unchanged from 1990, including the distribution among the three services. The Indian navy maintained the majority of its force structure. Even with the decommissioning of six Foxtrot-class submarines the fleet remained strong with 14 principal underwater combatants. The biggest departure was the decommissioning of the INS Vikrant leaving India with only one operational aircraft carrier. Similarly, additional reductions in operational frigates left the navy with one fewer principal surface combatants than in 1990 (27) and four fewer than in 1980 (30) despite intentions to expand total naval capabilities.

3.6.2 Factors Contributing to Military Modernization

India's military modernization in 2000-2004 corresponded with developments related to military industrial capacity, foreign supply, military obsolescence, and changes in the security threat environment.

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[59] The project was delayed for years; the submarine was finally delivered and commissioned into the Indian navy in 2012. Rajat Pandit, "Nuclear Submarine INS Chakra Inducted into Navy," *Times of India*, April 5, 2012.

[60] The submarine (K-152 *Nerpa*) was also the subject of an underwater disaster while under Russian control in November 2008, killing 20 personnel onboard.

Demand Variables

Military obsolescence was high this period for five reasons. First, the army possessed an aging fleet of 3,400 tanks, a combination of T-55s, Vijayantas, and T-72s. The newest of which, the T-72, was more than 20 years old and performed abysmally during the Persian Gulf War on the Iraqi side. Delay of the Arjun during the 1990s made procurement of an advanced tank in the early 2000s a top priority. Likewise, the US invasion of Iraq in 2003 reiterated the value of tanks in urban warfare. Second, the IAF was in desperate need of an advanced jet trainer, which the IAF was operating without for two decades. Third, replacement of the MiG-21 fleet continued to be a top priority. This was achieved through licensing production of the Su-30. Fourth, the army's fleet of light-utility helicopters had reached its operational limits. The army's operational Chetak and Cheetah helicopters were down from 150 and 130, respectively, in 1990 to 120 and 40 in 2000. This issue was addressed with the completion of the ALH program and delivery, in 2002, of the first of an eventual 300 Dhruv helicopters from HAL.[61] These 2.5-ton light helicopters had been developed in the 1980s-90s with design assistance from Germany's MBB and used imported engines.[62] Fifth, the navy faced reductions in its submarine fleet and naval aircraft. During this period three more Kalveri-class submarines were decommissioned with the last two to be decommissioned subsequently. In addition, only a dozen Sea Harriers remained in service, leaving the navy unable to maintain full naval aerial patrols from its only remaining carrier.

[61] The Indian army received its first three Dhruv helicopters in 2002; 76 had been delivered to the army and air force by 2008; about 225 were produced by 2017 (mostly for the army and air force with smaller numbers in the navy and coast guard); and the 300th helicopter was produced in 2020.

[62] The helicopter originally had a Honeywell engine that was blocked by US sanctions after India's 1998 nuclear tests, and the helicopter then used a French engine (initially a Turbomecca engine, and by the 2010s an Ardiden engine, renamed Shakti and coproduced by HAL).

The security threat environment remained high this period following tensions with Pakistan and China's growing power. First, tensions with Pakistan lingered following the nuclear tests in Period 4; however, several factors weakened Pakistani internal stability, including a stalled economy, militant terrorism, weak political institutions, and unstable political leadership. Second, China experienced exponential economic and military growth. In 2001, the gap in military expenditure between China and India exceeded $10 billion for the first time. Within five years, China's defense budget grew 72% nearly doubling India's by 2004. At the same time, Beijing began making considerable infrastructure investments in areas around Tibet and quietly moving medium-range missiles into the region. These developments were further shadowed by the PLA's growing military capabilities which included advanced jet fighters, ballistic missiles, and a growing naval fleet. As Table 3.12 demonstrates, China rose to second place on the CINC as its T5-Prop score rose to 32 percent, up from 26.1 percent in 1992. Meanwhile, India's relative position according to the T5-Prop indicator remained unchanged during the same time.

Table 3.12: 2002 CINC Top 5

Country	**Rank**	**CINC**	**T5 Prop.**
US	1	15.4%	32.2%
China	2	15.3%	32.0%
India	3	7.3%	15.3%
Russia	4	5.0%	10.4%
Japan	5	4.9%	10.2%

Supply Variables

Military industrial capacity during 2000-2004 remained low, which constrained military modernization in this period. Despite strong economic growth throughout the period and a renewed focus on national security following the skirmishes with Pakistan between 1999 and 2002 India fell short of its target goals. Four factors contributed to low military industrial capacity: (1) insufficient military expenditure and investment in defense programs, (2) low human capital, (3) low R&D, and (4) counterproductive government policies. During this period India experienced an average 5.7 percent economic growth. Growth in military expenditure, however, did not keep pace and only averaged 4.6 percent growth throughout the period. In 2004, military expenditure topped $31.7 billion, approximately 4.2 percent of GDP. India's economic growth saw improvement in several sectors, including high-technology exports (as % of manufactured exports) which rose to 6.3 percent. These figures still paled in comparison to China's rise, whose relative high-technology exports rose to 24 percent.[63]

R&D rose to an average $529 million during this period, but still remaining at a low level. Surprisingly, this figure more than doubled R&D expenditure in Period 4. This large increase in R&D spending is a direct result of economic growth and the shortcomings of several high-profile MWS from the 1990s, including the Tejas fighter jet. The shift in R&D funding was intended to accelerate these programs and many others. India achieved modest gains with the commencement of production on two indigenous programs, but still lacked improvement in important weapons systems and human capital. First, the Arjun tank and Dhruv helicopter each began production in 2000, nearly one decade behind schedule. The Arjun program, however, did achieve higher levels of indigenous content, although no replacement for the German engine. The program's success was hampered by the program's high cost and extended delays resulting in a modest order for about 120 units. A year later the MoD entered into a contract for the licensed production of the Russian T-90S tank, thus signaling the army's procurement preference (by the 2010s, India had about 1,000 of these tanks). The Dhruv program achieved greater procurement numbers as well as better prospects for export.

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[63] *World Bank*, World Development Indicators, accessed November 2020.

Human capital indicators continued to remain low thus limiting the talent pool from which to draw engineers and technicians for arms programs. Between 2000 and 2004, tertiary education enrollment rose to 11 percent, an increase of just 2 percent for the period. This is significant because during the same period China expanded tertiary enrollment by nearly 10 percent. Human capital continued to be a major obstacle to enhancing MIC in this period. India's problems with education and personnel management extend from multiple factors. Among the more prevalent factors inhibiting education in India is a lack of equal access to higher education institutions and insufficient political commitments. The problem also extended to employers who provide inadequate in-service skills training.[64] According to the World Bank, only 16 percent of Indian manufacturing firms provide in-service training to their employees.[65] This pales in comparison to most developed states where the rate is above 80 percent. Thus, India possessed a profound "skills-gap" throughout its economy.

Finally, India instituted three key policy reforms during this period. First, the MoD allowed FDI in India's arms industry, up to 26 percent. This opening to FDI by foreign companies would allow the much needed infusion of foreign technology. Second, the MoD began to encourage co-production of MWS. In the past, India either procured weapons off-shelf or produced them independently. The new emphasis on co-production would encourage the creation of critical relationships with foreign arms contractors and promote not just the transfer of foreign technology but the absorption of it. Finally, India embarked upon an extensive internal review of its national security strategy and approach to military modernization. The 1999 Kargil conflict had an enduring impact on national security policymaking in India. In 2000, the

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[64] "Country Strategy for the Republic of India for the Period of FY2009-2012," The World Bank, November 14, 2008, pp 4-5.

[65] Ibid, p. 6.

MoD issued the Kargil Review Committee Report which outlined multiple factors that contributed to the unexpected nuclear standoff with Pakistan. Among the factors highlighted was the qualitative gap in military technology between India and Pakistan. The committee observed that "significant cost and time overruns" plague the armed services and India faces an inherent dilemma between "make" or "buy" when it comes to military technology. While the report makes few specific recommendations, it does argue for greater competition, technological spin-off with the civil sector, and harnessing "national talent."[66]

Table 3.13: Major Policy Developments in Indian Military Modernization

1991	Diversification of foreign arms suppliers
1994	Establishment of six Special Task Forces to initiate reform
2000	Publication of Kargil Review Committee Report
2000	Publication of Ministerial Committee report on national security
2001	Establishment of Integrated Defense Staff
2001	Establishment of Joint Command
2001	Defense Industry opened to private sector (100%) and FDI (26%)
2003	Establishment of Strategic Forces Command
2003	Transition from licensing to co-production of foreign weapon systems
2004	US-India rapprochement (NSSP)
2004	Introduction of Cold Start military doctrine
2004	Establishment of Kelkar Committee to reform DRDO
2006	Articulation of joint operations
2006	Introduction of Defense Procurement Procedure & Manual
2008	Publication of Rao Committee Report on DRDO reform
2009	Establishment of joint foreign defense ventures
2014	Adjustments to FDI, establishment of defense reform committees

Foreign supply was moderate this period due to a combination of domestic political reforms and US rapprochement. First, following a series of defense reviews and committee reports, Indian policymakers began implementing a series of political and organizational reforms aimed at improving arms procurement and military responsiveness.[67] Among the more significant policy changes was the acceptance of private investment and FDI in the domestic

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[66] Government of India, *From Surprise to Reckoning: Kargil Committee Report*, February 25, 2000 (New Delhi: Government of India).

[67] The committees and defense reports were established in light of a series of limited conflicts with Pakistan from 1998-2002.

arms industry, up to 100 percent private and 26 percent foreign. Second, following the 9/11 terrorist attacks, the US began to re-engage India and Pakistan. Among the benefits of improved relations was beginning negotiations for future arms packages.

To summarize, the combination of high military obsolescence and high security threat environment contributed to high demand for military modernization. Notably, India's projected estimated value of military modernization jumped to its highest level since Period 1. This was almost certainly a result of several factors, including an improved economy, high security threat environment (driven by foreign attacks including terrorism in major cities), and US rapprochement. At the same time, low military industrial capacity and moderate foreign supply resulted in low-moderate arms supply overall. By this point, several indigenous MWS programs were far behind schedule or underperforming expectations. While US rapprochement did not immediately lead to US arms transfers, the diplomacy and removal of sanctions sent a strong signal to other MWS suppliers, particularly in Europe. Combined with high military obsolescence, which neared critical levels in some areas, low military industrial capacity forced major changes in defense policy and procurement. What is unclear during this period was the impact of China's growing capabilities on India's defense planning. By this time, China was achieving high military modernization, but this was not clearly reflected in Indian defense plans, which were defined by Pakistan and terrorism. Under these conditions, the military modernization for this period was moderate and near the high threshold and much greater than the previous period (projected estimated value of military modernization was near $17 billion).

3.7 PERIOD 6: 2005-2009

3.7.1 Developments in Military Modernization

Table 3.14: Indian MWS Acquisitions, Period 6					
Designation	Category	Supplier	Year	Quantity	Projected Estimated Value
Scorpene	Submarine	France	2005	6	$4,500
IL-38	ASW Aircraft	Russia	2005	2	N/A
MiG-29K	Fighter Aircraft	Russia	2005	16	$700
2S6M Tunguska	Mobile AD	Russia	2005	28	$400
BM-9A52 Smerch	Mobile RL	Russia	2005	28	N/A
BMP-2	Inf Fighting Veh	Russia	2006	123	$90
USS Trenton	LCS	US	2006	1	$48
Talwar-class	Frigate	Russia	2006	3	$1,500
T-90S	Tank	Russia	2006	347	$866
Jaguar-S	Attack Aircraft	UK (L)	2006	20	$534
Sea King	Helicopter	US	2006	6	$39
Heron	UAV	Israel	2006	16	$250
Tejas	Fighter Aircraft	Indigenous	2006	20	$390
Su-30 MKI	Fighter Aircraft	Russia	2007	58	$1,600
DO-228	Transport Aircraft	Germany	2007	12	$600
C-130 Hercules	Transport	US	2008	6	$1,000
Mi-17 V5	Helicopter	Russia	2008	80	$1,300
Spyder-MR	Mobile SAM	Israel	2008	18	$260
P-8A Poseidon	ASW Aircraft	US	2008	8	$2,000
Project-71	Aircraft Carrier	Indigenous	2009	1	$3,000
Total:					**~$20,000**

(L): Units built under license

In July 2005, President Bush and Prime Minister Singh agreed to a framework to establish civil nuclear cooperation between the two nations. Under the agreement India would separate its civil and military nuclear facilities and open them to International Atomic Energy Agency inspections and safeguards. Later approved by the US Congress in 2008, the US-India Civil Nuclear Agreement opened the door to previously restricted Western technology (dual-use related) as well as US military hardware. As a result, the US aggressively courted India as a primary arms client for a wide range of MWS and subcomponents, including lucrative licensing deals to pacify Indian offset policies. While Russia remained India's top arms supplier, the US began to fill several key gaps, including heavy transport aircraft and amphibious transport.

Subsequently, India's military modernization consisted of key developments in fighter aircraft, transport aircraft, transport and attack helicopters, aircraft carrier capabilities, naval destroyers, and attack submarines. First, India purchased three supplemental aircraft, began an upgrade program, and initiated competition for a future multi-role combat aircraft (MRCA). The IAF acquired additional units of the MiG-29, Su-30MKI, and Jaguar-S which already operated in its fighter squadrons. In 2009, India and France agreed to a $2 billion modernization program to upgrade 51 Mirages and extend their service lives. Russia also agreed to upgrade India's fleet of 45 MiG-29Ks for $2 billion.[68] The MiG-29Ks are slated for use onboard the 44,000-ton INS Vikramaditya which was delivered in 2013. These modernization programs were intended as a stopgap until a next generation fighter (LCA) could be acquired. Additionally, the burgeoning US-India arms relationship began with transport deals to include C-130 aircraft and Sea King helicopters. In 2008, India ordered 80 Russian Mi-17 V5 heavy transport/attack helicopters to begin replacing the older Mi-17s.

In terms of naval capabilities, India began construction of the indigenous Project-71, a 40,000-ton aircraft carrier, in 2009.[69] Significant delays, including a shortage of steel, delayed the ship's delivery for years. (Eventually, the carrier was floated in its dry dock in late 2011, launched in 2013, basin trials were completed in 2020, and sea trials were expected in 2021-2022). The carrier is expected to deploy 20-30 naval LCA variants and 24 upgraded MiG-

[68] Rajat Pandit, "India to commission its first supersonic naval fighter squadron," *Times of India*, May 10, 2013.

[69] This aircraft carrier project had been conceptualized much earlier: India's government sanctioned a Project-71 Air Defense Ship in 1999, which received formal government approval in 2003, and was reconceptualized as an Indigenous Aircraft Carrier in 2006.

29Ks.[70] Additionally, India ordered six Scorpene diesel-electric attack submarines from France (these eventually entered service starting in 2017 through the early 2020s). The $3 billion deal included full technology transfer, with all six submarines built at Mazagon Docks in Mumbai. The Scorpene is among the most modern diesel-electric submarines in the world and features air-independent propulsion enabling it to remain submerged for longer periods of time. And, in 2006, India ordered three additional Talwar class frigates from Russia to augment its existing three Talwar frigates (these were delivered and commissioned in the early 2010s).

3.7.2 Explanation of Developments in Military Modernization

India's military modernization in 2005-2009 was influenced by India's military industrial capacity, foreign supply, military obsolescence, and changes in the security threat environment.

Demand Variables

In terms of India's high military obsolescence this period, India faced five issues. First, the last Kalvari-class attack submarine was decommissioned in 2010, reducing India's conventional submarine fleet to 15, down from 18 in the mid-1990s. Similarly, defense planners had to begin preparing for the decommissioning of its second-generation submarine fleet, the Sindhugosh-class (Kilo) which began service in 1986. Of the 10 Sindhugosh submarines, eight completed mid-life refits by 2011. Second, the Indian navy's total principal surface combatants were reduced to 21 vessels following the decommissioning of one destroyer and five frigates. This issue was addressed by ordering three Talwar-class frigates from Russia and continued work on three indigenous Kolkata-class destroyers (the first was launched in 2006 and

[70] Vladimir Karnozov, "First Three Upgraded MiG-29UPGs Delivered to India," *Aviation International News*, December 21, 2012. The 2008 contract for the modernization will extend the aircrafts' lifespans by 3,500 hours.

commissioned in 2014). Third, the army began the process of retiring 700 T-55 tanks and some early variants of the T-72. This problem was addressed through licensed production of the T-90. Fourth, the IAF faced block obsolescence of its fleet of medium and heavy transport helicopters. Nearly 80 Mi-8 medium-lift helicopters and 30 Mi-17s faced retirement or expensive upgrades. The MoD addressed this issue with the purchase of 80 additional Mi-17s in 2008.[71] Fifth, the IAF managed to maintain its total combat capable aircraft above 700 through 2012 but exhausted any extension of its MiG-21 fleet. By the late 2010s, the IAF risked losing one-third of its total combat aircraft when the remaining 264 MiG-21 fighters were scheduled to be retired.[72] (Since 1964, India has operated nearly 900 MiG-21 fighters and has implemented two modernization programs to extend their service life). The IAF's fleet of over 100 Jaguars and the navy's 11 remaining Sea Harriers also faced retirement. This problem was addressed through procurement of the Rafale, LCA, Su-30, and MiG-29K.

The security threat environment dropped to moderate this period following improvements in regional stability; however, China's rapid economic and military modernization continued to outpace India in nearly every indicator. First, the PLA's budget eclipsed $116 billion by 2009, nearly three times the size of India's.[73] Second, this growth in expenditure and R&D has manifested in a significant expansion of capabilities. Since 2000, the PLAN has grown from 60 principal surface combatants to 78 and its submarine fleet has grown from 65 to 71, including three nuclear powered ballistic missile submarines. In addition, China's People's Liberation

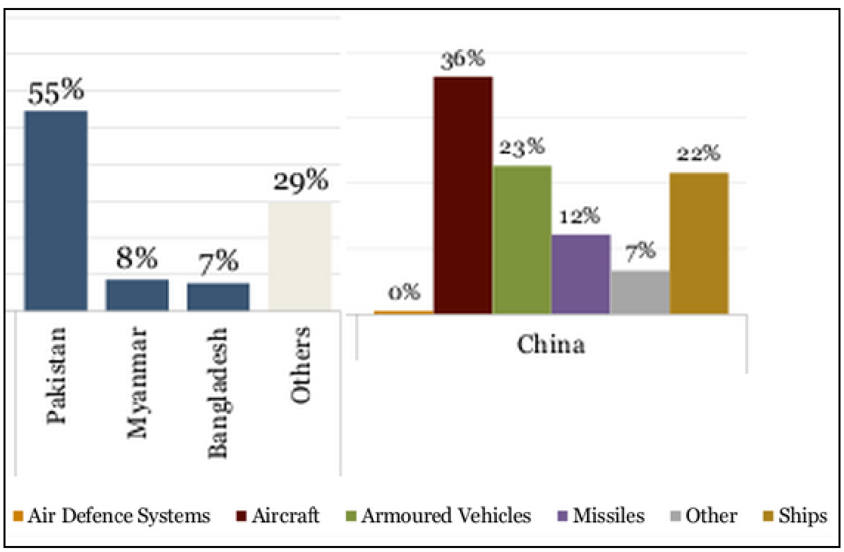
[71] The 80 Mi-17 ordered in 2008 were delivered starting in 2011-12. India's Mi-17 fleet grew so that it in 2010 it had 100 Mi-8 and 72 Mi-17 (also called Mi-8MT); and then by 2020 India had 35 Mi-17; 45 Mi-17-1V; and 148 Mi-17V-5. Source: *The Military Balance*, 2010 and 2021.

[72] Vinay Kumar, "MiG-21bis likely to serve IAF until 2019," *The Hindu*, June 16, 2013.

[73] SIPRI, Military Expenditure Database, accessed 15 June 2013.

Army Air Force (PLAAF) has retired over 1,500 early Soviet-era J-6 and J-7 fighters and replaced them with fourth-generation J-10s and J-11s.[74] Third, the PLA is increasingly exporting its advancing capabilities with India's neighbors. As Figure 3.1 below demonstrates, China actively courted India's neighbors through lucrative arms deals. As China's capabilities continue to grow so too may the likes of Pakistan and Bangladesh. These deals were further reinforced by major infrastructure projects financed by China. These projects include deep water ports like the ones in Gwadar, Pakistan, and Sonadia, Bangladesh (which was eventually dropped). For China, building closer relations with India's neighbors not only helps hedge against India but also serve economic interests since many of China's Western provinces are landlocked and benefit by connecting them to ports in the Bay of Bengal.

Figure 3.1: China main arms recipients and type[75]



Fourth, China continued to make significant improvements in the infrastructure in areas near Arunachal Pradesh and Aksai Chin, relocating ballistic missiles and SAM missiles throughout

[74] From 2000-2012 the PLAAF's total combat aircraft declined from 3,000 to 1,600 aircraft demonstrating a major shift from quantitative superiority to emphasis on qualitative superiority in aerial capabilities.
[75] SIPRI, Arms Transfers Infographics, accessed December 2013.

Tibet.[76] In addition, reoccurring border incursions by PLA soldiers into Ladakh prompted India to mobilize 40,000 additional soldiers along the Chinese border.[77] Finally, as the CINC suggests in Table 3.15, China's position vis-à-vis India grew further. Since 1992, China's proportion of capabilities among the top five states rose from 34 percent to 37.6 percent. Meanwhile, India's proportion did not change. Together, these indicators have prompted greater vigilance and urgency amongst Indian defense planners to implement military modernization plans and expand capabilities.

Table 3.15: 2007 CINC Top 5

Country	Rank	CINC	T5 Prop.
China	1	18.6%	37.6%
US	2	15.0%	30.3%
India	3	7.7%	15.6%
Russia	4	4.1%	8.3%
Japan	5	4.0%	8.1%

Supply Variables

Military industrial capacity changed to moderate this period due to three factors: (1) expanded military expenditure, (2) low human capital, (3) increases in R&D, and (4) defense policy reforms.

India's GDP rose to $1.1 trillion (high) by 2009, elevating it to the third largest economic power in the world. Between 2005 and 2009, economic growth averaged approximately 6 percent, demonstrating its advancement as a major economic exporter. Despite the growing economy, high-technology exports (as % of manufactured exports) remained stagnant at 6.8 percent. India's economy remains contingent upon agriculture, services, and textiles. The

[76] "China deploys new CSS-5 missiles on border with India," *Times of India*, August 17, 2010.

[77] Vivek Raghuvanshi, "India Adding 40,000 Mountain Troops at China Border," *Defense News*, June 12, 2013.

inability to steadily expand high-tech industries remains a concern and signals underlying issues within the economy (e.g. low FDI and brain drain). The steady growth in India's economy enabled several changes in India's defense planning, including an increase in military expenditure. While it did not grow as fast as the economy, India's military expenditure rose 44 percent for the period.

During this period R&D reached a moderate level and averaged $1.2 billion, more than double the average spent in Period 5. Despite the increase there was instability throughout DRDO and the arms labor pool. According to one report, only 25% of recent graduates in India are employable.[78] Even more alarming was Defense Minister AK Antony's admission that 700 scientists and engineers had left the DRDO in the span of six years.[79] The ongoing exodus is supposedly sparked by poor human resource policies and declining facilities. Such events would have long-term effects on India's indigenous programs as MWS require stability and leadership through all development phases.

India's arms producing companies also underperformed despite increased expenditure. For instance, India possesses three companies in the top 100 of arms-producing and services in the world, the same number as Israel, but fewer than Italy, Germany, Japan, and Australia.[80] The arms producing heavy-weights such as the US, France, and Russia all possess eight or more. In

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[78] *The Wall Street Journal*, "Mere 25% graduates in India are employable: Mercer Consulting," February 21, 2008.

[79] *Times of India*, "700 scientists quit DRDO in last six years, defence minister says," December 6, 2012.

[80] SIPRI, "The SIPRI Top 100 arms-producing and military services companies in the world excluding China, 2011," April 2012.

this case, the imbalance in civil-military relations is likely hurting the arms industry.[81] This factor is further compounded by the industry's inward focus towards Indian requirements.

Human capital rose to a moderate level this period as indicators saw significant improvement. The talent pool expanded from which arms programs to draw engineers and technicians. Between 2005 and 2009 tertiary enrollment rose to 20 percent. While still lagging much of the developed world, this period represents India's largest growth in tertiary enrollment.[82] This factor is aided by the expanding economy which has created new education opportunities as well as increased political emphasis on education. Furthermore, the government and the DRDO have realized the importance of minimizing its brain-drain and retaining critical skills among its workforce. In recent years the DRDO has turned towards the nation's research institutes and the Indian diaspora; however, the issue still remains a critical vulnerability.[83]

Since 2005, India implemented multiple policy reforms that improved conditions in military modernization. Among these reforms, two are significant in terms of their impact and potential. First, in 2006, the MoD published its long-awaited manual of Defense Procurement Procedures which streamlined many of the policies and bureaucratic entanglements that inhibited arms acquisition. More importantly, it made it easier for foreign companies to engage the MoD on potential projects. Second, beginning in 2006, the MoD embarked on a campaign to attract joint-ventures on military projects in India. Defense planners began courting major foreign arms-producing companies including Lockheed Martin, Boeing, BAE Systems, and Northrop

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[81] Cohen and Dasgupta, *Arming Without Aiming*, pp. 159-163.

[82] *World Bank*, World Development Indicators, accessed November 2020.

[83] Rajat Pandit, "DRDO turns to NRIs to reverse brain drain," *The Times of India*, March 13, 2008; and "India tops Asia in brain drain to US," *Business Insider*, January 14, 2016.

Grumman. Together, these indicators reveal that military industrial capacity was low for this period thus constraining India's ability to modernize its military.

Foreign supply changed to high during this period due to greater access and supplier competition. As discussed above, through licensing agreements, India saw an exponential growth in the number of joint development projects and transfer of military technology. Second, the increased access and openness to 'new' suppliers has enabled the MoD to issue requests for proposal (RFP) and arms tenders. As a result, India's foreign arms procurement became more diversified. For example, since 2000, Russia's share of India's foreign arms transfers declined from 90 percent to 50 percent. In the case of the MRCA, six venders competed for the aircraft's contract.

To summarize, the combination of high military obsolescence and moderate security threat environment corresponded with moderate-high demand for military modernization. At the same time, moderate military industrial capacity and high foreign supply resulted in moderate-high arms supply overall. Notably, India experienced improvement in several military industrial capacity indicators, which may be reflected by the increase in indigenous MWS produced in this period. But this improvement did not detract from foreign arms procurements, which continued steadily and expanded to include US arms. Diplomatic relations with the US steadily grew as well, which were influenced by considerations of China's growing power. Both the US and India were the drivers of this improved relationship because both perceived that could help their respective countries versus China. Nonetheless, high military obsolescence and a moderate security threat environment helped drive foreign weapons acquisition. Under these conditions, military modernization was high (the projected estimated value of military modernization was approximately $20 billion for this period).

3.8 Period 7, 2010-2014

3.8.1 Developments in Military Modernization

Table 3.16: Indian MWS Acquisitions, Period 7					
Designation	Category	Supplier	Year	Quantity	Projected Estimated Value
C-17A Globemaster	Transport Aircraft	US	2010	10	$4,100
MiG-29K	Fighter Aircraft	Russia	2010	29	$1,100
Su-30 MKI	Fighter Aircraft	Russia (L)	2010	42	$1,600
Heron & Searcher	UAV	Israel	2010	4	$152
Hawk-132	Trainer Aircraft	UK (L)	2010	57	$1,100
Tejas	Fighter Aircraft	Indigenous	2010	20	$830
Mirage-2000-5 upgrade	Fighter Aircraft	France	2011	49	$2,400
Mi-17 V5	Helicopter	Russia	2012	71	$1,600
Saryu-class vessel	Corvette	Indigenous	2012	4	$600
SA-315B Lama	Helicopter	France	2013	20	$48
PC-7	Trainer Aircraft	Switzerland	2013	75	$800
C-130J	Transport Aircraft	US	2013	6	$1,100
Visakhapatnam-class	Destroyer	Indigenous	2013	4	$4,000
Total:					**~$20,000**

(L): Units built under license

India completed several large arms deals with multiple suppliers beginning in 2010. Russia, however, maintained its position as India's largest arms supplier, notably naval vessels and fighter aircraft. India's greatest security threats continued to be Pakistan-sponsored terrorism, regional insurgency, and Chinese provocation. In particular, the 2008 Mumbai attacks, in which 171 people were killed, remained fresh in the public conscience. Likewise, Indian officials were acutely aware of the growing defense cooperation between Pakistan and China. This period saw deeper diplomatic relations prosper between India and the US, culminating in several major arms transfers and discussions about co-production. Security concerns and Hindu-nationalism helped propel Narendra Modi and the BJP to power in 2014.

Subsequently, India's military modernization this period consisted of key developments in transport aircraft, fighter aircraft, transport and attack helicopters, naval destroyers, and attack submarines. Initially, India ordered six C-130s and 10 C-17As from the US following the completion of the 2008 civil-nuclear energy deal. Then in January 2013, Airbus emerged as the preferred bidder to supply six A330 aerial refueling tankers for an estimated $1 billion.[84] The deal marked a defeat for Russian supplier Ilyushin, due in part by the A330's ability to refuel a mix of fighter types while operating from the high-altitude IAF base at Leh in the Himalayas.

As for fighter aircraft, India opted to upgrade its 50 Mirage 2000 for about $1.9 billion, to bring the aircraft to Mirage 2000-5 standards (the first were delivered to the IAF in 2015).

In terms of transport helicopters, India ordered an additional 71 Russian Mi-17 V5 heavy transport/attack helicopters to replace older Mi-17s in 2012.[85]

In terms of naval capabilities, India continued work on the indigenous Vikrant-class carrier program (formerly Project-71) as the original INS Viraat was officially decommissioned in 2017. In addition, the MoD approved the building of four Visakhapatnam destroyers (Project 15B, based on the same hull design as the Kolkata-class Project 15 but with better technology) in 2009.[86] This new class of guided-missile destroyers could have augmented stealth characteristics. India also inducted four Saryu-Class 2,300-ton corvette-type patrol vessels that were delivered to the navy between 2012-2014.

In terms of submarines, India lost the INS Sindhurakshak in August 2013 to an onboard explosion, ultimately sinking the vessel. Yet the Indian Navy had already solicited production and design assistance from France for the Kalvari-class program. The Kalvari-class is a diesel-

[84] Anthony Osborne, "Airbus Military Prevails In Indian Tanker Selection," *Aviation Week*, January 7, 2013.

[85] Vivek Raghuvanshi, "Russia, India Sign Helicopter, Jet Deal," *Defense News*, December 24, 2012. Eventually, these helicopters were delivered from early 2014 to 2016.

[86] The keels for these four vessels were laid down in 2013-2018, and the first three were launched for trials in 2015-2019.

electric vessel based on the French-Spanish Scorpene-class. The first of which, the INS Khanderi, was designed by France but built in India. It began sea trials in 2015 and was commissioned in late 2017. By the early 2020s, India would have a total of six such submarines. Additionally, although this dissertation does not examine nuclear forces, it should be noted that India's first indigenously built nuclear-armed nuclear-powered submarine (SSBN) was launched in 2009-2010 and commissioned in 2016, and a second began sea trials in 2017-2018.

3.8.2 Factors Contributing to Military Modernization

India's military modernization in 2010-2014 was influenced by India's military industrial capacity, foreign supply, military obsolescence, and changes in the security threat environment.

Demand Variables

Military obsolescence this period remained high due to significant decreases in force structure. By 2010, India possessed just 632 combat capable fighter aircraft, a net loss of 220 since 2005. Similarly, the Navy's fleet of surface combatants dropped from 54 to 45 during the same time span. Each of these drops was the direct result of military obsolescence outpacing procurement and production. While the IAF could claim high qualitative capabilities, its shortage of fighter squadrons leaves substantial gaps in India's defense strategy. Indian policymakers blame this drop on underperforming defense programs, while defense planners blame the policymakers for inadequate funding and convoluted procurement procedures. Thus, military obsolescence was a significant factor driving military modernization.

Furthermore, the military risked losing operational integrity due to failure to maintain and operate MWS. Between 2010 and 2013, the IAF lost 29 fighter planes (12 Mig-21s, 8 MiG-27s, 4 Su-30 MKIs, 2 Jaguars, 2 Mirage-2000s, and 1 MiG-29).[87] The exact source of each accident remains unknown but defective manufacturing and inadequate maintenance have been endemic to Indian MWS throughout history. The results are two-fold. First, Indian policymakers were reluctant to permit major arms purchases if the military cannot maintain and operate them effectively. Second, the high accident rate reinforced military preferences for foreign arms as opposed to the 'defective' ones produced/licensed in India.

The security threat environment was moderate-high due to decreased border tensions; however, China continued to outpace India in nearly every national indicator. This gap is exemplified in Table 3.17 which shows China's growing relative national capabilities. Notably, the PLA's budget eclipsed $120 billion in 2010, nearly three times India's budget.[88] Second, growth in expenditure and R&D manifested in a significant expansion of capabilities. Since 2000, the PLAN has grown from 60 principal surface combatants to 78. Its submarine fleet has grown from 65 to 71, including three nuclear powered ballistic missile submarines.

Table 3.17: 2012 CINC Top 5

Country	Rank	CINC	T5-Prop
China	1	21.8%	42.4%
US	2	13.9%	27.1%
India	3	8.1%	15.7%
Russia	4	4.0%	7.8%
Japan	5	3.6%	6.9%

While less explicit than Western defense strategy reports, India's MoD annual reports have increasingly addressed China's rise and its destabilizing effect on the global balance of power.

[87] "IAF Lost 29 Fighter Planes in Past 3 Years, AK Antony Says," *Times of India*, March 11, 2013.

[88] SIPRI, Military Expenditure Database; accessed June 15, 2020.

> *India also remains conscious and watchful of the implication of China's increasing military profile in our immediate and extended neighborhood, as well as the development of strategic infrastructure by China in the border areas. India is also taking necessary measures to develop the requisite capabilities to counter any adverse impact on our own security*.[89]

Thus, a higher-threat security threat environment and changes in the global balance of power have permeated the highest echelons of Indian defense planning. Likewise, the evolution of India's annual reports demonstrates the expansion of its defense priorities beyond immediate threats and aligned them with its power aspirations.

Supply Variables

Military industrial capacity was moderate during this period due to three factors: (1) expanded military expenditure, (2) low human capital, (3) increases in R&D, and (4) defense policy reforms.

India's economy stagnated between 2008 and 2010, but returned to 6 percent annual growth by 2011, once again enabling increased defense expenditure. By 2016, Indian military expenditure eclipsed $51 billion, an increase of 44 percent over the course of the decade.[90] Furthermore, nearly 20 percent of expenditure was going towards capital outlays, a clear sign of India's extensive procurement strategy. But growth in the economy remained uneven as high-technology exports (as % of manufactured exports) plateaued around 7.5 percent. The cause of this stagnation is unclear.

Similarly, R&D expenditure stagnated at around $1 billion until reinvestment in 2013-2014, finally reaching $2 billion by the end of the period. The demand for increased R&D

[89] Government of India, Ministry of Defense, *Annual Report: 2013-2014* (New Delhi: Government of India), p. 8.

[90] SIPRI, Military Expenditure Database, accessed March 18, 2013.

funding was largely driven by India's naval production programs, which ran into numerous difficulties during construction. In terms of human capital, India experienced positive growth, eclipsing 20 percent tertiary enrollment in 2010; however, this growth tapered off during this period and remained below 30 percent. Likewise, many of the personnel management problems addressed in Period 5 continued to plague India's defense industrial base.

In terms of policy changes, Indian policymakers signaled their intent to reaffirm India's procurement preferences, with foreign acquisition being a last resort. In 2013, the MoD approved amendments to the Defence Procurement Procedures (DPP) in an effort to streamline procurement procedures and prioritize domestic arms production.[91] The updated procedure outlines acquisition preferences accordingly:

1. Buy Indian
2. Buy and make Indian through joint ventures
3. Make Indian through indigenous development
4. Buy and make with foreign technology transfers
5. Buy global

The likelihood of the "new" DPP dramatically altering India's arms procurement patterns remains low but it could also signal a return to foreign self-restriction. Military preferences continue to favor foreign arms and political considerations are still susceptible to external factors. If Pakistan or China achieves certain qualitative advantages, the "buy Indian" provision will likely be bypassed in favor of the state-of-the-art available on the international arms market.

[91] Ministry of Defense, "DAC Approves Major Changes in DPP to Encourage Indian Defence Industry," (New Delhi: Government of India, April 20, 2013). See also Vivek Raghuvanshi, "India's New Rules Could Mean More Overseas Tie-ups," *Defense News*, April 30, 2013.

The MoD further revealed in 2013 that it would pursue additional partners to develop the Kaveri aircraft engine rather than work solely with France's Snecma.[92] Likewise, Bharat Electronics Limited (BEL) signed a joint-venture contract with France's Thales to manufacture air defense components including radars.[93] India multiplied its joint production projects and is making efforts to encourage not just additional input, but deeper technological cooperation as well. (One of these was an $11 billion contract proposed in 2012 to co-produce Russia's fifth-generation fighter aircraft, the Sukhoi T-50.[94] The T-50 prototype had begun test flights in 2010 which meant India was entering at a "mature" point in the program. India, however, pulled out of this program in 2018 due to concerns of the program's progress.)

Additionally, India and the US initiated the Defense Technology and Trade Initiative (DTTI) in 2013 and followed it with a joint declaration on defense cooperation signed by President Obama and Prime Minister Manmohan Singh.[95] The agreement followed a string of India-US working groups and it is designed to enhance defense technology transfer, trade, research, co-development, and co-production of MWS. The relationship with the US is particularly critical for India's military modernization given that seven of the world's top ten arms-producing companies are American.[96] Together, these indicators reveal that military

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[92] Neelam Matthews, "India Considers New Partnership Options For Kaveri Engine," *Aviation International News*, February 4, 2013.

[93] Neelam Matthews, "Thales, India's BEL To Form Joint Venture for Radars," *Aviation International News*, 24 August 2012. The deal will also likely fulfill offset requirements prompted by the MRCA deal.

[94] Jay Menon, "India and Russia to Ink R&D Phase of T-50 Program," *Aviation Week*, 21 August 2012.

[95] Subimal Bhattacharjee, "Ball set in motion to carry forward defence ties between India-US," *The Economic Times*, August 14, 2014.

[96] Aude Fleurant, Sam Perlo-Freeman, Pieter D.Wezeman, Siemon T. Wezeman and Noel Kelly, "The SIPRI Top 100 Arms-Producing and Military Services Companies", December 2015, SIPRI Fact Sheet.

industrial capacity was low for this period thus constraining India's ability to modernize its military.

India continued to benefit from high foreign arms supply, which remained the first choice of India's defense leaders as its indigenous programs continued to lag. The MoD and DRDO further expanded on its joint development projects and the transfer of military technology through licensing agreements, including the French Scorpene submarine program, Russia's Su-30MKI, and the UK Hawk trainer aircraft.

To summarize, the combination of high military obsolescence and a moderate-high security threat environment corresponded with high demand for military modernization. At the same time, moderate military industrial capacity and high foreign supply resulted in moderate-high arms supply. By this period security threat environment considerations over China's rise began to dominate India's defense planning as the PLAN expanded operations in the Indian Ocean and the Chinese military was improving its logistics and forces along the Indian border. Despite marginal increases in military industrial capacity and having several indigenous MWS under production, India could not meet its requirements without foreign weapons procurement. Likewise, slow growth in military expenditure meant that India could not match China's military modernization levels through either domestic production or foreign procurement. The lack of major defense policy reforms and low high-technology exports likely reflect deeper challenges in India's military industrial capacity. Notably, India's foreign arms purchases consisted of few significant technology transfers from Western suppliers. Under these conditions, there was high military modernization during this period (with a projected estimated value of $20 billion).

3.9 Period 8, 2015-2018

3.9.1 Developments in Military Modernization

Table 3.18: Indian MWS Acquisitions, Period 8					
Designation	Category	Supplier	Year	Quantity	Projected Estimated Value
AH-64E Apache	Helicopter	US	2015	22	$1,300
CH-47F Chinook	Helicopter	US	2015	15	$1,000
Global 5000	AGS Aircraft	Canada	2015	2	$300
ERJ-145	AEW&C Aircraft	Brazil	2015	2	$210
Arihant-class	Submarine	Indigenous	2016	2	$2,500
Kamorta-class Project 28	Corvette	Indigenous	2015	4	$1,500
P8A Poseidon	ASW Aircraft	US	2016	4	$1,000
Rafale	Fighter Aircraft	France	2016	36	$8,000
SA-315B Lama	Light Helicopter	France	2017	8	$43
Talwar	Frigate	Russia	2018	4	$2,000
Nilgiri-class	Frigate	Indigenous	2017	7	$7,000
Total:					**$25,000**

(L): Units built under license

Despite Prime Minister Modi's increased emphasis on national security, military modernization and defense expenditure continue to decrease as a proportion of the government budget and even the overall defense budget. This has not stopped the MoD from pursuing numerous lucrative MWS contracts, many of which were pending for years or unfulfilled due to budgetary restrictions. In dollar value, the largest orders were Rafale aircraft and Nilgiri class frigates.

One of the key areas of growth was navy principal surface combatants, which grew from 25 to 28 this period with the addition of three new Kolkata-class destroyers that were commissioned in the period 2014-2016.[97] To supplement the destroyers, the navy also ordered 11 frigates: four Talwar-class ships from Russia (two were to be delivered in the early 2020s, and

[97] These destroyers had been under construction beginning 2003-2005 and had been launched for trials in 2006-2010.

two constructed in India for delivery in the mid-2020s) and seven Nilgiri-class Project 17A to be built indigenously (the first was launched for trials in 2019). India also inducted four Kamorta-class / Project 28 anti-submarine stealth corvettes that were commissioned in 2015, 2016, 2017, and 2020.

Meanwhile, the tactical submarine fleet remained unchanged at 14 but with the MoD's expressed interest in expanding the fleet to 24. The navy also raised a second squadron of naval fighters equipped with MiG-29K after decommissioning its last Sea Harrier squadron. The navy expanded long-range maritime surveillance with the P-8I Poseidon aircraft from the US. The navy's Maritime Capability Perspective Plan – 2012-2027 – envisions a force of 200 warships and 500 aircraft to control its Indian Ocean domain in the face of encroachments from Pakistan and China.

In terms of helicopters, India ordered 22 US Apache AH-64D multirole combat helicopters and 15 Chinook CH-47F heavy-lift helicopters from Boeing.[98] [99] The deals represented a significant departure from Russia as the primary supplier for heavy military helicopters.

In terms of fighter and ground attack aircraft, India settled for the procurement of 36 Rafales for an estimated $8 billion as a stopgap measure from France following the collapse of the medium multi-role combat aircraft (MMRCA) competition (the first Rafale entered service in 2020). The IAF worked with the strength of 30 squadrons, well below the 42 fighter squadrons assessed as the minimum needed for a two-front war. The DRDO's Advanced Medium Combat Aircraft (AMCA) projects remain in development with no clear timetable, which may prompt

[98] Jen DiMascio, "Indian Air Force To Buy 22 Apache Helos," *Aviation Week*, September 25, 2012.

[99] Santanu Choudhury, "India Lines Up Boeing for $2.4 Bln Helicopter Orders," *The Wall Street Journal*, November 6, 2012.

additional stopgap procurements or additional Tejas orders (in 2020-2021, India ordered about 80 additional Tejas). A large number of Tejas or other fighters are needed to replace the IAF's obsolescent MiG-21 and MiG-27 fighters, most of which have retired without replacements.[100]

The IAF also needed more force multipliers, particularly air-to-air refueling tankers and airborne warning and control systems (AWACS). It obtained two Embraer-145 aircraft from Brazil that were fitted with Indian-built 'Netra' Airborne Early Warning and Control systems—the planes were inducted into India's air force in 2017 and 2019. These supplemented India's three Phalcon AWACS systems that were acquired from Israel in 2009-2011.

3.9.2 Factors Contributing to Military Modernization

India's military modernization in 2015-2018 was influenced by India's military industrial capacity, foreign supply, military obsolescence, and changes in the security threat environment.

Demand Variables

Military obsolescence was high due to widespread block obsolescence across all three services, but especially in the Air Force and Navy. According to one report, the military was estimated to be short "300 fighter jets, at least a dozen submarines, over 1,000 combat helicopters, seven frigates and perhaps 3,000 artillery guns."[101] Combat capable fighter aircraft in the IAF decreased from 866 to 849 by 2018. The Navy officially decommissioned the aircraft carrier INS Viraat in 2017 while India's second indigenous aircraft carrier had yet to be

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[100] Franz-Stefan Gady,"Ajai Shukla on the Current and Future State of India's Military," *The Diplomat*, September 25, 2019.

[101] "Opportunity Strikes," *The Economist*, April 16, 2016.

approved and laid down. Thus, military obsolescence was a significant factor driving military modernization.

The security threat environment remained moderate-high for multiple reasons. First, China's trajectory in key indicators continued to increase. The PLA's budget eclipsed $120 billion in 2015, nearly three times India's budget.[102] Second, growth in China's military expenditure and R&D manifested in a significant expansion of capabilities, which began translating into a more expeditionary foreign policy. China established a naval port in Pakistan (Gwadar) and its first overseas base in Djibouti, thus significantly expanding its presence in the Indian Ocean. Third, Chinese and Indian forces engaged in a standoff in June 2017 in Doklam (on the Bhutan border). Indian forces intervened to stop China's construction of a road in Bhutan-claimed territory. The two sides clashed again in August 2017 at Pangong Lake that resulted in dozens of injuries on both sides. While both sides de-escalated, the series of events demonstrated that the border dispute would continue to be a major flashpoint.

In terms of official policy, India continued to expand on the threat of China in its annual defense report. [103] In 2015, the Indian MoD expanded on its definition of its "neighborhood" and security threat environment to include areas beyond its immediate territory. According to the MoD's 2015-2016 Annual Report:

> *India is also impacted by developments beyond its immediate neighborhood and the Indian Ocean region. Developments in West Asia, Central Asia and the Asia Pacific have a direct bearing on India's interests. In all these regions, we are witnessing major political and economic shifts with strategic implications. While many of these transitions are marked by growing volatility and violence, at the same time, inter-linkages of globalization and deepening economic*

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[102] SIPRI, Military Expenditure Database, accessed April 19, 2020.

[103] Yogesh Joshi and Anit Mukherjee, "Offensive Defense: India's Strategic Responses to the Rise of China," in Kanti Bajpai, Selina Ho, Manjari Chatterjee Miller, eds., *Routledge Handbook of China-India Relations* (London: Routledge, 2020).

interdependence are also increasingly evident. Consequent re-calibrations and dynamics in the global balance of power, that are also driven by the rise of emerging economies and multipolarity, have created further uncertainties in the strategic outlook.[104]

The MoD further underscored significant changes in the global balance of power in 2019:

It is increasingly evident that the world is undergoing rapid and unexpected changes, described by some as tectonic shifts. The world is in a transition, driven by rapidly evolving security and technological challenges, causing stresses in international order and transforming the global hierarchies.[105]

Supply Variables

Military industrial capacity was moderate during this period which enabled new developments in military modernization. India continued to experience strong economic growth and a more stable security threat environment. Three factors contributed to moderate military industrial capacity: (1) expanded military expenditure, (2) low human capital, (3) increases in R&D, and (4) defense policy reforms.

India's GDP growth peaked in 2016 at 8.2 percent before decreasing to 6.8 percent in 2018. By 2018, GDP eclipsed $2.8 trillion. This growth was not reflected in high-technology exports (as % of manufactured exports) as that sector grew little, averaging just 8 percent this period. On the other hand, sustained strong economic growth enabled military expenditure to grow from $51 billion in 2015 to $66 billion in 2018 (current USD). Similarly, military R&D grew from $1.5 billion, approximately 5.5 percent of the MoD budget, in 2015/2016 to $2.4 billion in 2018/2019.[106]

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[104] Ministry of Defense, *Annual Report: 2015-2016*, p. 8.

[105] Ministry of Defense, *Annual Report: 2018-2019*, p. 2

[106] Based on 12,491 and 17,610 rupees crore, respectively, reported in *Annual Report – 2015-2016* and *Annual Report 2018-2019*, p. 12 and p. 16, respectively.

In terms of human capital, India’s tertiary enrollment stagnated, increasing from 27 percent to 28 percent during the period. It is unclear what predicated this slow trend due to mostly favorable economic conditions throughout the period, but the strong economy and slowing tertiary enrollment growth may have negatively impacted human capital availability.

In terms of reforming defense procurement, Modi’s administration adopted a dual-track process to reform.[107] First, the Modi government established a series of committees to adjust procurement policies and force the public firms to compete. Second, the government established several initiatives to promote greater private sector competition and foreign investment. The government rebranded its indigenization policy into “Buy IDDM” (Indigenously Designed, Developed and Manufactured).[108] Buy IDDM built on the “Make in India” initiative established in 2016 which set out to establish new strategic partnerships as prescribed in the 2016 Defense Procurement Procedure, including identifying private sector champions that could more easily earn defense contracts. According to one analysis, many of the Modi initiatives have been designed to “empower the private sector to play a greater role in defense research and development (R&D) and manufacture, rather than providing preferential treatment to the MoD’s nine defense public sector undertakings (DPSUs) and 41 ordnance factories (OFs), which have monopolized defense manufacture for decades and continue to do so despite government promises of a level playing field for the private sector.”[109] To date, most of these reforms can be categorized as minor to moderate as they have not yet yielded major advancements or restructuring of the DPSUs or OFs or their dominance. It remains unclear if the increase in FDI

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[107] “Waking the Beast: India’s Defense Reforms Under Modi,” *The Diplomat*, December 16, 2016.

[108] “Dawn of a new era in the Indian defence industry,” *Forbes India* online, July 20, 2017.

[109] Franz-Stefan Gady,“Ajai Shukla on the Current and Future State of India’s Military,” *The Diplomat*, September 25, 2019.

from 49 to 74 percent will be enough to promote significant investment by major international defense firms.

India continued to benefit from high foreign arms supply. Military arms trade grew with the US in this period while Russia maintained its position as India's dominant arms supplier. Russia continued to provide arms with fewer restrictions, greater systems support, and at lower costs compared to other major competitors. However, sanctions enacted against Russia following the 2016 US election interference complicated the state of several arms transfers to India.[110] The MoD and DRDO further expanded on its expansion of joint development projects and the transfer of military technology through licensing agreements, including US aircraft carrier technology, potential US fighter aircraft, French submarine technology, and the on-again-off-again Russian Su-57 stealth fighter program.[111] As Figure 3.2 demonstrates, India's foreign arms supply has changed significantly over time as Russia's share has been cut by increasing US and Israeli arms.

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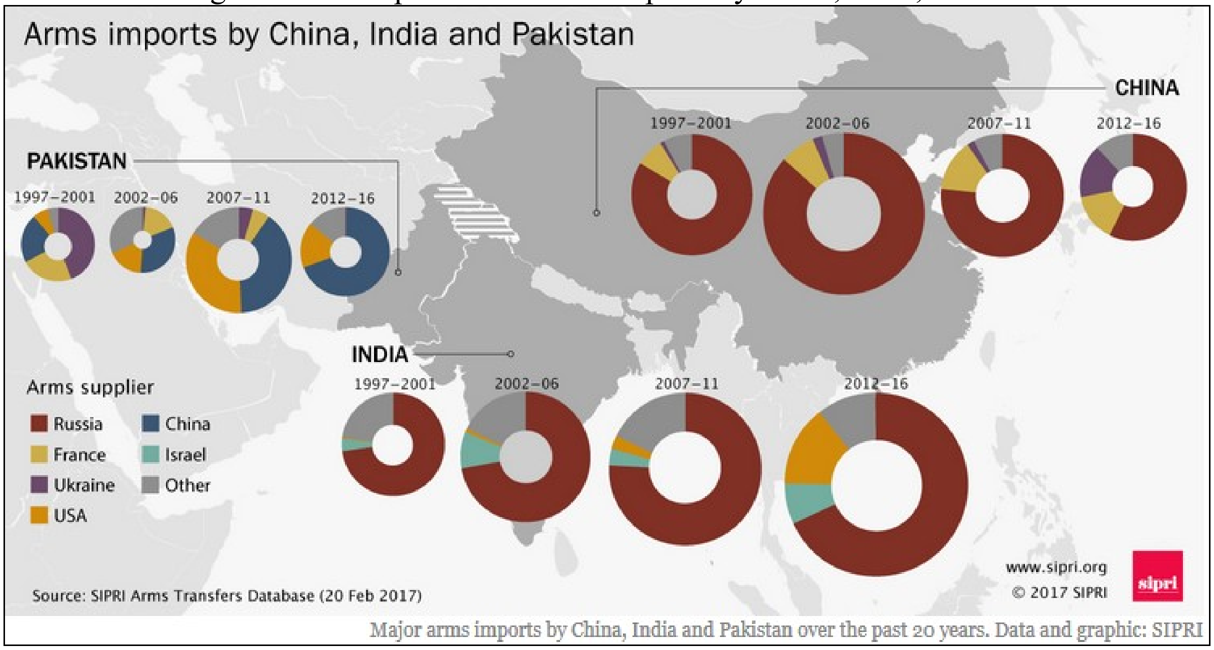
[110] Vivek Raghuvanshi, "US sanctions are affecting India-Russia defense deals: MoD source," *Defense News* online March 9, 2017.

[111] Franz-Stefan Gady, "Russia Offers India its Su-57 Stealth Fighter (Again)," *The Diplomat*, July 19, 2019.

Figure 3.2: Comparison of Arms Imports by China, India, and Pakistan[112]



To summarize, the combination of high military obsolescence and moderate-high security threat environment contributed to high demand for military modernization. At the same time, moderate military industrial capacity and high foreign supply contributed to moderate-high arms supply. Figure 3.2 highlights several key trends, one of which was China's expanding weapons exports to Pakistan. This dynamic affected India's security environment calculus because it indicated a growth in opponent capabilities, not just on a qualitative level but also on a strategic level. On top of this, China was developing a port that could be used as a naval base and had invested in numerous infrastructure projects in Pakistan. This dynamic likely impacted changes in India's defense policy reforms and increased R&D to better improve military industrial capacity. Certain sectors of India's military industrial capacity, particularly naval production, improved, but India still underperforms in other areas like attack aircraft and fifth-generation technologies like stealth high-performance unmanned systems. Likewise, because India cannot indigenously match China's military modernization, its dual preference for both Russian and

[112] SIPRI, Arms Transfer Database, accessed February 20, 2021.

Western MWS reflects a renewed prioritization on state-of-the-art MWS in an effort to match China qualitatively in certain areas. Under these conditions, military modernization was high (with a projected estimated value of $25 billion for this period).

3.10 CONCLUSION

As a result of its military modernization, India inducted several modernized weapons systems into its armed forces by the late 2010s and early 2020s. In 2020, its navy comprised one 40,000-ton aircraft carrier with a second of similar tonnage near completion; 10 destroyers of 6,000-7,000 tons; 12 frigates (three of 6,000 tons and nine of 4,000 tons); and 8 corvettes and patrol vessels of 2,000-3,000 tons. The IAF had about 30 fighter squadrons (each with typically 16 aircraft plus trainers and spares), though many of these were expected to retire in the 2020s.[113] India's army had about 3,600 main battle tanks, including 120 Arjun, 2,400 T-72, and 1,100 T-90S tanks. This chapter has shown that the influence and combined interaction of military industrial capacity, available foreign suppliers, military obsolescence, and the security threat environment all contributed to military modernization in India.

In regards to military industrial capacity, an inability to pursue, absorb, and adapt foreign technology limited India's domestic arms industries. Unlike China, India did not possess a deliberate program to assimilate foreign military technology. This study found no significant linkages between the Indian intelligence services and India's various defense production companies. It was not until the 2010s that India sought extensive dual-production programs for projects like fifth-generation stealth attack aircraft and its aircraft carrier program, with Russia and the US, respectively. Due to an inability to reliably develop and produce MWS at home,

[113] As per the IISS *Military Balance 2021*, India's air force then had 60 fighters (54 MiG-29 and 7 MiG-29UB); 500 fighter ground attack planes (150 MiG-21, 50 Mirage 2000, 12 Rafale, 260 Su-30MKI, and 16 Tejas); and 110 Jaguar attack aircraft.

defense planners were encouraged to procure completed arms from abroad, though India still had enough industrial capacity to produce some systems via licensing. This demonstrates the counter-intuitive nature of military innovation and self-sufficiency—procurement and exploitation of foreign technology is essential to developing the foundation of long-term self-sufficient military industrial capacity. While the Jaguar-S attack aircraft was co-produced via license, it is not clear that the later indigenous LCA Tejas represented any technological advancement, which makes its delayed development all the more concerning.

In regards to available foreign suppliers, India only faced one brief period of limited access via sanctions but constrained itself for over 30 years through restrictive import-substitution and investment policies. Due to these constraints, India's arms companies were excluded from major advancements in military technology. Indeed, attracting foreign direct investment in its arms industry remains a struggle. While China used a more coercive approach, India likely needed to provide more incentives earlier in its military modernization. Aside from detracting investment from military industrial capacity, prolonged foreign arms dependency creates another problem—compatibility and technological path-dependency. MWS require extensive training programs, maintenance, and spare parts. After a certain point, armed services are no longer able, nor willing, to accommodate new or exotic weapons systems due to the latent logistical consequences. Few weapons and subsystems are compatible across similar MWS built by different states. This remains a significant issue even for NATO. As a result, the threshold for armed services to accept indigenous MWS over familiar foreign ones becomes significantly higher without bureaucratic intervention.

In regards to military obsolescence, constant pressure from imminent reductions in capabilities and changes in technology encouraged defense planners to procure arms from abroad. India's intense security competition with Pakistan left little room for vulnerabilities in either quantity or quality of MWS. This variable put constant pressure on India's defense budget and likely undermined military industrial capacity which could not meet the high requirements presented by the respective armed services. Thus, underperforming military industrial capacity, underscored by numerous delayed programs, and an intense security threat environment compounded India's military obsolescence problems.

In regards to the security threat environment, the dynamics of power and security changed significantly from 1980 to 2018. India began shifting its security concerns from Pakistan towards China by the 2010s. This had several implications. The Pakistan threat was always manageable due to India's larger size and greater capabilities. China, on the other hand, poses a much different dynamic. With marginally superior numbers in both population and military personnel, and with much greater economic resources, China's rise as a great power creates challenges for India that can no longer be mitigated without significant changes in strategy and policy. This distinction has influenced efforts for more significant changes in military industrial capacity and for leveraging new foreign suppliers like the US.

In sum , military modernization in India has changed considerably since 1980, however, some of its fundamental vulnerabilities still persist. India still relies on foreign suppliers for many of its MWS and heavy arms. It also possesses an intense and dynamic security threat environment. Additionally, India faces a multitude of domestic challenges, to include low economic development and growth, complicated bureaucratic politics, internal security threats, sectarianism, weak infrastructure, and certain resource scarcities, and these domestic challenges hinder efforts to advance military industrial capacity. Despite these limitations, India has managed to maintain and, in some areas, expand its military capabilities. India possesses a robust naval shipbuilding program, sophisticated intelligence platforms, heavy transport capabilities, and greater experience in operating its power-projection capabilities. While it has not managed to achieve all of its self-sufficiency and status goals, India has succeeded in expanding many capabilities and maintaining an arsenal of modern weapons despite limited defense expenditure. The story of India's military modernization history is one of persistent growth, but varying from small-scale to larger-scale across time periods. It has done so without antagonizing the international community (with the exception of the 1998 nuclear tests). Yet, the same cannot be said for China.

Chapter IV

Military Modernization in China

Stagnation and progress in China's military modernization is influenced by changes in military industrial capacity, foreign supply, military obsolescence, and the security threat environment. Since 1980, China's military modernization stagnates when combinations of these variables register low but progresses when combinations of these variables register moderate to high. These trends are shown in Table 4.1 and discussed below.

Table 4.1: Summary of China Variables

Year	Military Industrial Capacity	Available Foreign Supply	Military Obsolescence	Security Threat Environment	Military Modernization
Period 1 (1980-1984)	LOW	LOW	MODERATE-HIGH	LOW	LOW
Period 2 (1985-1989)	LOW	LOW	MODERATE-HIGH	LOW	LOW
Period 3 (1990-1994)	LOW	LOW-MODERATE	HIGH	MODERATE	MODERATE
Period 4 (1995-1999)	MODERATE	LOW-MODERATE	HIGH	HIGH	MODERATE
Period 5 (2000-2004)	MODERATE	MODERATE	HIGH	MODERATE-HIGH	HIGH
Period 6 (2005-2009)	HIGH	LOW	HIGH	MODERATE	HIGH
Period 7 (2010-2014)	HIGH	LOW	MODERATE-HIGH	MODERATE	VERY HIGH
Period 8 (2015-2018)	HIGH	LOW	MODERATE	MODERATE-HIGH	HIGH

During the period 1980-1984, China's military modernization was low corresponding to a stable security threat environment and a shift in national priorities. In the period 1985-1989, military modernization remained low during a stable security threat environment and political emphasis on economic reform. In the period 1990-1994, military modernization was moderate corresponding to restricted financial resources and low-moderate access to foreign suppliers. In the period 1995-1999, military modernization was moderate at a time of moderate military industrial capacity, high military obsolescence, low-moderate foreign arms supply, and a high security threat environment. In particular, new Russian arms supplies and a standoff over Taiwan reinforced military modernization efforts. In the period 2000-2004, expanding military industrial capacity, high military obsolescence, and a moderate-high security threat environment contributed to high military modernization. In the period 2005-2009, increased military industrial capacity and high military obsolescence contributed to high military modernization. In the period 2010-2014, improved military industrial capacity and increasing tensions in the security threat environment, especially vis-à-vis the US, influenced very high military modernization. Finally, in the period 2015-2018, high military industrial capacity and moderate-high security threat environment contributed to high military modernization. Thus, military modernization in China was highest in the periods 2005-2009, 2010-2014, and 2015-2018 when multiple independent variables registered moderate to high.

The following section describes the evolution of China's defense policies and the rapid expansion of its capabilities. This is followed by a detailed analysis of eight periods of military modernization in China. The final section develops the analytic conclusions for the China case.

4.1 Background on Chinese Defense Policy

For the majority of China's modern history, its military doctrine followed the concept of People's War, centered on the importance of defending the continental homeland. Power projection forces, including naval and aerial capabilities, were considered secondary assets since China's policymakers assumed that actual military combat would take place on the Chinese mainland. During the 1950s, Chairman Mao Zedong and the Chinese Communist Party (CCP) modeled the People's Liberation Army (PLA) and its arms industry after the Soviet system.

The 1950s saw considerable military and technological cooperation between the two Communist regimes until the Sino-Soviet split in 1960. Without Soviet assistance, China, which already ideologically and politically differed with the West, became further isolated from international suppliers and trading partners. It thereby slowly "eroded into obsolescence" in terms of its arms and industrial capabilities.[1] As a result of this isolation and the Cultural Revolution of the 1960s, China became technologically stagnant, reliant upon indigenous production of 1950s-era Soviet legacy military systems. The exception to this was China's investment in its nuclear weapons program, successfully testing its first atomic bomb in 1964 and developing ballistic missiles and a nascent nuclear submarine program in the early 1970s.

Following the death of Mao Zedong in 1976, China began a transitional period of political and military reforms led by Deng Xiaoping. Military doctrine was adapted under the slogan "People's War Under Modern Conditions." This strategy called for greater mobility and mechanization of the PLA, particularly in the event of a Soviet-oriented conflict. But Deng and CCP leaders realized early on that the costs of transforming the military wholesale were too high in the near-term. By 1985, Chinese leaders undertook a sweeping reassessment of the international security threat environment and determined that the probability of major war was low. As a result, the Chinese leadership re-prioritized the "Four Modernizations" (agriculture, industry, science & technology, and defense), with defense becoming distinctly last.[2] Thus, Deng decided to forego military spending for economic investment. This conclusion led to a comprehensive reformation of the entire PLA and the arms industry. Furthermore, it bought time until the civilian economy could better serve its military industrial base.

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[1] Paul H. Godwin, "China's Defense Modernization: Aspirations and Capabilities," *Washington Journal of Modern China* Vol. 6, No. 1 (Spring 2000), p. 15.

[2] David Shambaugh, *Modernizing China's Military: Progress, Problems, and Prospects* (Berkeley, CA: University of California Press, 2004), p. 2-3.

Modern Political and Military Reforms

In 1980, the PLA totaled 4.5 million personnel, with 80 percent concentrated in the ground forces. Beginning in 1985, military regions were consolidated from 11 to seven, and 37 field armies were consolidated into 24 group armies. By 1988, 1.5 million personnel were cut from the PLA ranks, including thousands of senior Mao-era commanders and generals.[3] Personnel reductions were paralleled by a major reduction in defense expenditure. Total expenditure declined from a high of $40 billion in 1982 to just $10.8 billion by 1987. In 1980, the PLA navy possessed only 38 major combatant ships and 97 attack submarines. The air force possessed over 5,000 aircraft, the vast majority of which were Chinese copies of the Soviet MiG-19 and MiG-21.[4] China minimized major weapon system (MWS) procurement, choosing only to selectively equip certain units.[5] Likewise, despite improved relations with Western states and better access to foreign technology, Beijing continued to prefer supporting its indigenous arms industry. In 1988, the seven ministries of machine building (MMB), which handle arms production, were consolidated into four ministerial-level organizations.

The PLA continued to undergo significant reform throughout the 1990s, in part due to three major events: the Tiananmen Square massacre in 1989; the Persian Gulf War in 1991; and the third Taiwan Strait crisis in 1995-1996. The Tiananmen Square incident had severe

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[3] Many of the disbanded units were transferred to the People's Armed Police (PAP), and various other reserve units.

[4] For more on the PLA prior to 1980 see Roy Kamphausen and Andrew Scobell, ed., *Right Sizing the People's Liberation Army: Exploring the Contours of China's Military* (Carlisle Barracks, PA: Strategic Studies Institute, 2007); Mark A. Ryan, David M. Finkelstein, and Michael A. McDevitt, eds., *Chinese Warfighting: The PLA Experience Since 1949* (Armonk, NY: M.E. Sharpe, 2003); and Bruce A. Elleman, *Modern Chinese Warfare, 1795-1989* (New York: Routledge, 2001).

[5] James C. Mulvenon, "The PLA Army's Struggle for Identity," in Stephen J. Flanagan and Michael E. Marti eds., *The People's Liberation Army and China in Transition* (Washington, DC: National Defense University Press, 2003), p. 121.

international ramifications, resulting in a voluntary arms and technology embargo supported by the US and European states. The Persian Gulf War on the other hand demonstrated the changing dynamics of warfare, ushering in the latest Revolution in Military Affairs (RMA). The RMA symbolized the growing gap in military capabilities between the PLA and the Western powers that employed state-of-the-art systems. Thirdly, escalating tensions over Taiwan reconfigured China's security priorities. Collectively, these events have been a driving force in China's military modernization, transforming not only doctrine and training but also arms procurement.

In 1993, the arms industry was reformed again in an effort to reduce redundancy across the ministries and ultimately "corporatize" them.[6] This reformation removed some of the over-centralization of the defense industries. The reforms also reversed the 1988 consolidation by dissolving the four MMBs and creating six new ones.

By the end of the 1990s, the PLA's military doctrine shifted from "People's War Under Modern Conditions" to one defined as "Active Defense." While the ground forces maintained its important role of protecting Chinese sovereignty over the homeland, a renewed emphasis involved shifting towards the importance of littoral naval and air capabilities and defense of China's periphery. The strategy changes were epitomized by the 1997 National Defense Law developed at the end of the CCP's 15th National Congress. This was the first party Congress following the death of Deng Xiaoping, enabling President Jiang Zemin to consolidate power and devise an updated national strategy. President Jiang, who had also served as Chairman of the Central Military Commission since 1989, announced another reduction in military personnel in 1998, totaling 500,000 by the end of the decade. Given the ascendancy of naval and air

[6] Shambaugh, *Modernizing China's Military*, p. 232.

modernization, the reductions disproportionately impacted PLA ground forces.[7] Furthermore, military expenditure began to rebound from the deep cuts in the mid-1980s. Between 1995 and 1999, defense expenditure grew by 50 percent, from $20.9 billion to over $31 billion. Fueling this increase was a sharp rise in arms procurement, including several large arms transfers from Russia.

On the heels of the 15th National Congress, a final round of military industrial reforms was enacted in 1998 leading to several key changes. First, the General Armament Department (GAD) was created as a central oversight body to supervise the entire military industrial complex.[8] The GAD's primary purpose is to manage research and development (R&D) and arms production across the six MMBs. Second, the Commission on Science, Technology and Industry for National Defense (COSTIND) was reconfigured and placed under the supervision of the State Council.[9] Third, five of the six ministerial-level arms corporations were expanded into ten with greater specialized roles.[10] The goal of this latter move was intended to infuse greater competition but had the latent consequence of cementing divisions of labor in research and production. Each of these moves was another major attempt to streamline investment and improve efficiency. This, however, has led the Chinese government to pursue the contradictory goals of increased central planning and improved production.

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[7] The 1998 Defense White Paper outlined the reductions as follows: 19 percent of total ground forces; 11.6 percent of total naval forces; and 11 percent of total air force personnel. Of the 500,000 personnel disbanded, 84 percent were from the ground forces.

[8] The GAD was modeled after the French Delegation generale pour l'armement (DGA).

[9] This division of labor has reportedly created turf wars between the two agencies without clear and distinct missions.

[10] The sixth, the China State Shipbuilding Corporation, was converted into entirely commercial operations.

Finally, in 2008, COSTIND was consolidated and reorganized as the State Council's State Administration for Science, Technology and Industry for National Defense (SASTIND). The new organization was placed under the new Ministry of Industry and Information Technology (MIIT). This move ultimately provides the GAD with greater authority over arms programs. This reform has made SASTIND more comparable to the US's Defense Advanced Research Project Agency (DARPA) in the US, which manages select defense projects and emerging capabilities.[11]

Despite these multiple attempts at reform several problems persist. First, the GAD and SASTIND have little interaction with ground-level units within the PLA to evaluate and customize equipment, let alone receive end-user requirements. Second, the GAD stands as a firewall between the users within the PLA and the specific arms producers, complicating design finalization of MWS. Third, the GAD and SASTIND are organized in such a way that prohibits the identification and assimilation of new technology. Finally, the GAD and SASTIND frequently block cross-pollination between the defense and civilian technology sectors.

To summarize, the Chinese arms industry has undergone four rounds of reform, each recognizing past failures. Despite these changes, problems of duplication, tension, and over-centralization persist in the procurement process.

EXAMINING CHINA'S MILITARY MODERNIZATION

China's military modernization from 1980 to 2014 can be examined in eight periods: 1980-1984, 1985-1989, 1990-1994, 1995-1999, 2000-2004, 2005-2009, 2010-2014, and 2015-2018.

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[11] Ed Francis and Susan M. Puska, "Contemporary Chinese Defense Industry Reforms and Civil-Military Integration in Three Key Organizations," The Study of Innovation and Technology in China, Policy Brief No. 5 (September 2010), pp. 1-4.

PERIOD 1: 1980-1984

4.2 Developments in Military Modernization

Table 4.2: Chinese MWS, 1980-1984					
Designation	Category	Supplier	Year	Quantity	Projected Estimated Value
Luda-class	Destroyer	Indigenous	1980	4	$800
AS-365/565 Panther (Z-9)	Helicopter	France (L)	1980	30	$200
SA 321 Super Frelon (Z-8)	Helicopter	France (L)	1981	22	$400
Han-class Type 091	Submarine	Indigenous	1980	2	$700
Y-8	Transport Aircraft	Indigenous	1983	8	$200
Type-053 H	Frigate	Indigenous	1980	3	$450
Type-053 H1	Frigate	Indigenous	1982	9	$1,800
S-70C-2 Blackhawk	Helicopter	US	1984	24	$140
Total:*					**$4,500**

(L) – Denotes licensed production of systems
* – Rounded to nearest 500

China's military modernization in this period consisted of three key developments as shown in Table 4.2. During this period China's armed forces made advancements in: (1) naval vessels such as frigates and destroyers; (2) nuclear attack submarines; and (3) transport and multirole helicopter capabilities, as well as some transport aircraft.

In terms of naval destroyers, the People's Liberation Army Navy (PLAN) launched four additional Luda-class missile destroyers. The Luda-class was developed during the late-1960s and first commissioned in 1971. At 3,000 tons displacement, the Luda was the largest indigenously built warship at the time. Based on the Soviet Kotlin-class destroyer, the Luda is armed with a wide-range of capabilities including surface strike, anti-submarine warfare, air defense, and at-sea replenishment. During this period, the PLAN launched four Luda vessels, bringing its total to 14. The Luda program was a substantial achievement for China, enabling the ship-building industry and PLAN designers to gain valuable experience in developing large surface combatants. The Luda-class would eventually undergo multiple upgrades through the

1990s with added capabilities. China also augmented its frigate fleet. It then had 11 of the Type 053 H frigate and added three more of this type in 1980, followed by nine of the Type 053 H1 from 1982 through 1988.

In regards to nuclear attack submarines, the PLAN commissioned two Han-class submarines in 1980 and 1984. The nuclear-powered submarine program was initiated much earlier, with the first vessel commissioned in 1974.[12] This initial submarine faced numerous technical difficulties, delaying further construction of additional submarines until 1977. Eventually two of these additional submarines were commissioned in 1980 and 1984. Equipped with six 533mm torpedo tubes and capacity for 20 torpedoes or 36 mines, the Han-class submarine represents a major technological feat for the PLA (considering it had not developed an indigenous diesel-electric submarine first). Given its early priority, the Han program, while it did not carry nuclear weapons, was a pivotal stepping-stone to developing an undersea nuclear deterrent.

In regards to transport and multirole helicopters, the PLA acquired both the 6-7-ton SA 321 Super Frelon and the 2-3-ton AS 565 Panther from France. In addition, the 5-ton S-70C Black Hawk was procured from the US. The Super Frelon represents the PLAN's first helicopter to operate on a surface combatant. Designed in two variants, anti-submarine warfare and search and rescue, the Super Frelon enabled the PLAN's growing surface fleet to expand and coordinate operations. After acquiring 13 Super Frelons in the late-1970s, the PLA began producing the helicopter domestically (designation Z-8) by reverse-engineering, with a few dozen produced in

[12] It is speculated that France provided some technical assistance during the mid-1970s to overcome certain deficiencies.

the 1980s-90s and about 100 by the late 2000s.[13] The smaller multi-purpose Panther (a military version of the AS 365 Eurocopter Dauphin) is the primary helicopter operating across the PLAN's major surface combatants. The Panther operates for transport, naval operations, and anti-submarine warfare (ASW) duties. The ASW variants are equipped with French ORB-32 surface search radar, dipping sonar, sonobuoys, and SIGINT receivers. The Panther has since been indigenized as the Z-9, with over 200 of these multirole helicopters in the Chinese army and navy. Finally, the PLA procured 24 Black Hawk medium transport helicopters. The S-70Cs were equipped with General Electric T700-701A turboshaft engines. Despite inaccessibility to spare parts from the US, the helicopters remained in operation through the 2010s.

In terms of transport aircraft, the Y-8 (a Chinese version of the Soviet An-12) entered service in this period after flight tests the previous decade. Eventually, over one hundred were produced in various versions, including airborne warning and control and naval antisubmarine and maritime patrol versions. In the 2000s, this aircraft design was stretched into a more capable Y-9 (intended to match the US C-130) and it entered service in the 2010s.

4.2.1 Factors Contributing to Military Modernization

China's military modernization in 1980-1984 was influenced by its military industrial capacity, foreign supply, military obsolescence, and changes in the security threat environment. These variables can be categorized as demand or supply oriented.

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[13] Some reports suggest that early production of the Z-8 faltered, and China preferred the Mi-17 at the time, so that, in the 1990s, only about 15 Z-8 were built for each of the Chinese navy and army. By the late 2000s, some 100 Z-8 units had been built. Subsequently, China developed a new civilian version, the AC313 with Pratt and Whitney engines; it also built a military version with Chinese engines, designated Z-18 for the navy (that first flew in 2012) and Z-8G or Z8B for the army (that first flew in 2014).

Demand Variables

Military obsolescence in 1980-1984 was moderate-high due to a deep technological divide between China and the world's leading powers. While the PLA force structure possessed large quantities of arms (see Table 4.3 below) few could compete with the advancements made by Western states and the Soviet Union. In 1980, the PLA was still mass-producing Soviet MWS first introduced in the 1950s and 1960s. At the time, the PLA did not possess any MWS that incorporated digital computer systems or fired precision-guided munitions. In the case of fighter aircraft, Western states began rolling out fourth-generation fighters in 1978-1980. Meanwhile, much of the PLA Air Force (PLAAF) was composed of second-generation aircraft such as the J-5 (equivalent to the Soviet Mig-17) and J-6 (equivalent to the Mig-19). Thus, the PLA faced both high levels of technological and block obsolescence due to aging equipment, creating demand for modernization in this period.

Table 4.3: PLA Force Structure, 1980

	Type	Quantity
Tanks	Type 34/58	1,000
	IS-2	1,000
	T-59	6,000
	T-62	400
	T-63	600
	T-69	200
Aircraft	H-6/Tu-16	95
	B-5	450
	Tu-2	100
	F-2/Qiang-5	500
	J-4/5/6/7	3,900
Naval Combatants	Destroyers	12
	Frigates	17
	Escorts	9
	Attack Submarines	97
	Nuclear Submarines	2

The security threat environment in 1980-1984 was low. China benefited from both an improved security threat environment and increase in national capabilities. The Soviet Union remained the greatest threat to the Chinese homeland, but Moscow's invasion of Afghanistan in 1979 shifted much of that concern. That conflict enabled China's leaders to improve relations with the US and negotiate for arms cooperation. Likewise, the Chinese economy experienced substantial growth during the period. In 1983 and 1984 alone, Gross Domestic Product (GDP) growth exceeded 10 percent with major advancements in its manufacturing sector. As the Composite Index of National Capabilities (CINC) reveals, China possessed a high proportion of the world's capabilities, notably population and natural resources. As Table 4.4 demonstrates, despite a technologically weak military, China was still one of the most powerful states in terms of national capabilities.

Table 4.4: 1982 CINC Top 5

Country	Rank	CINC	T5 Prop.
USSR	1	17.3%	33.0%
US	2	12.8%	24.5%
China	3	11.7%	22.4%
India	4	5.4%	10.3%
Japan	5	5.2%	9.9%

Supply Variables

Military industrial capacity in 1980-1984 was low due to constraints placed on military investment and preparations for looming defense cuts. China's GDP of $203 billion restricted the state's ability to compete with the West and the Soviet Union in arms development and procurement. Reprioritization of state economic goals compounded China's limited defense expenditure, which remained constant at approximately $40 billion per year. Military production subsequently fell by an estimated two-thirds between 1979 and 1988.[14] Similarly, military R&D expenditure remained limited to approximately $750 million per year, with the majority dedicated to nuclear weapons and strategic rocket systems.[15] High-technology exports (as % of manufactured exports) were likely also limited since China remained a predominantly agricultural society; however, there is little data to evaluate this indicator. Human capital on the other hand constrained China's military industrial capacity as tertiary education was a low 1.8 percent. At this time, China's workforce was largely agrarian with low primary and secondary education. By comparison, tertiary enrollment reached 5.9 percent and 29.5 percent in India and Japan, respectively. Furthermore, total public expenditure on education as a percentage of GDP was 2.1 percent in 1982, a low figure for a developing nation.[16] Overall, the low level of military industrial capacity had a significant impact on modernization.

Foreign supply of MWS in 1980-1984 was low. China benefited marginally from improved Western relations but remained cut off from Soviet arms supplies. Negotiations for the 'Peace Pearl Project' with the US began in 1983, but would not be concluded until three years later. As a result, US arms transfers were limited to just helicopters and spare parts during this period. Despite limited foreign supply, the political reforms initiated in the late-1970s had a positive aspect. The reforms opened the door to European arms suppliers. While they did not provide many complete MWS (except helicopters) to the PLA, there was a substantial transfer of technology and critical sub-systems. In 1978, France began leasing production of its Crotale surface-to-air missile (SAM) systems. Germany on the other hand, already possessed a

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[14] Eric Arnett, "Military research and development in southern Asia: limited capabilities despite impressive resources," in Eric Arnett, ed., *Military Capacity and the Risk of War: China, India, Pakistan and Iran* (New York, N.Y.: Oxford University Press, 1997), p. 246.

[15] Ibid, p. 248.

[16] Enrollment and expenditure data taken from the World Bank.

longstanding relationship of supplying diesel engines since 1965. In 1981, Germany began leasing production of its BF8L diesel engine for various tanks, armored personnel carriers (APC), and self-propelled artillery. Thus, China's opening up in the late-1970s marginally improved its access to foreign military technology, allowing for some amount of modernization in this period.

To summarize, the combination of moderate-high military obsolescence and low security threat environment contributed to moderate demand for military modernization. At the same time, low military industrial capacity and low foreign supply resulted in low arms supply. China's determination of a low security threat environment, aided by confidence in their numerical advantages and nuclear weapons, had a significant impact on each variable. In particular, deferring plans to modernize the military meant accepting higher levels of military obsolescence and it de-emphasized the importance of available foreign suppliers as there was no longer a demand. Likewise, military industrial capacity was not a priority, however, overall economic development was a priority which likely benefitted the latter in the long run. The major defense policy reforms like reducing the PLA's size and restricting defense industries set an important precedent for future reforms and signaled a clear shift in managing the PLA. Under these conditions, military modernization was low in China (with a projected estimated value of about $5 billion for this period).

PERIOD 2: 1985-1989

4.3 Developments in Military Modernization

Table 4.5: Chinese MWS, 1985-1989					
Designation	Category	Supplier	Year	Quantity	Projected Estimated Value
J-8II	Fighter Aircraft	Indigenous	1985	200	$3,000
HMAS Melbourne	Aircraft Carrier	Australia	1985	1	$3
Type-80/88	Tank	Indigenous	1985	500	$600
Ming-class Type 035	Submarine	Indigenous	1986	4	$600
Jinhou	Tanker Aircraft	Japan	1987	4	$140
Han-class Type 091	Submarine	Indigenous	1988	2	$700
Type--053 H2	Frigate	Indigenous	1986	3	$600
AS-365/565 Panther (Z-9)	Helicopter	France (L)	1988	68	$680
Total:					**$6,500**

(L) – Denotes licensed production of systems

China's military modernization in this period consisted of three key developments as shown in table 4.5. During this period China's armed forces made advancements in: (1) fighter aircraft; (2) main battle tanks; and (3) submarines and naval vessels.

In terms of fighter aircraft, the PLAAF certified the J8-II for production in 1988. The aircraft is born from the J-8 program of the 1960s which was based on the Soviet MiG-21. The J-8II is a supersonic fighter aircraft developed by 601 Aircraft Design Institute and Shenyang Aircraft Corporation (SAC) for intercepting Soviet bombers. The aircraft since evolved into a multi-role aircraft with air-to-air combat and surface attack capabilities. The aircraft's capabilities and implementation were delayed due a lack of progress on developing and integrating an indigenous radar-homing medium-range air-to-air missile (MRAAM). As part of the 'Peace Pearl' Sino-US cooperation program initiated in 1986, the US provided substantial assistance in modernizing 55 J-8II fighters, including the Westinghouse AN/APG-66(V) radar, 1553B MIL-STD data bus, fire-control computer, head-up display (HUD), cockpit multifunctional displays (MFD), and navigation systems. The PLAAF produced over 200 units of the aircraft in 6-8 variants.

In terms of tank capabilities, China developed the Type-88, a second-generation indigenous tank, drawn from its earlier second-generation Type-80. The tank incorporated Western technology, including British fire-control system, German 730hp diesel engine, and Austrian 105mm rifled gun. The Type-80 /88 program was born in the late-1970s as a counter to expanding Soviet armor, to replace China's first-generation Type-59 and improved Type-59 versions called Type-69/79 (which were based on the Soviet T-54). Though the program was considered ambitious and intended to match the German Leopard II under development, only a few thousand Type-80s were produced including limited production of the Type-88 (400-500 units).

In terms of submarine capabilities, the PLAN launched three additional Ming-class diesel-electric attack submarines and two additional Han-class nuclear attack submarines (one Han was completed in 1988 and the other was launched in 1989 and completed by 1991). The additions of the Ming submarines were the first in nearly a decade after their production was suspended in 1979 following severe problems with the first three boats. While independently built, the Ming is nearly identical to the Soviet Romeo-class in design and arrangement. The second variant of the Ming-class launched in 1987 incorporated improved diesel engines, upgraded hull, sonar, and command systems. Due to its high acoustic signature, the Ming-class is predominately limited to coastal defense. Despite its vulnerabilities, the submarine remains a low-cost solution for surveillance and defense.

Lastly, China acquired Australia's HMAS Melbourne aircraft carrier for scrap metal.[17] The aircraft carrier was never operational with the Chinese navy, though it likely played a pivotal role in the start of China's aircraft carrier development program in subsequent decades.

4.3.1 Factors Contributing to Military Modernization

China's military modernization in 1985-1989 was influenced by military industrial capacity, foreign supply, military obsolescence, and changes in the security threat environment. These variables can be categorized as demand or supply oriented.

Demand Variables

Military obsolescence in 1985-1989 was moderate-high. The PLA continued to face widespread aging of its key MWS as well as its inability to keep pace with changes in military technology. The PLA only fielded improved prototypes rather than initiating serial production of key systems. These issues were compounded by low investment in arms production which limited the arms industry to just producing testing platforms and improving older weapons systems. Because of the limited access to arms suppliers and the continuation of Deng's military reforms, military obsolescence rose significantly. The PLA's readiness dropped due to entire air squadrons being grounded for inoperability along with several armored brigades. The Soviet arms embargo began to have systemic effects on the maintenance of MWS due to insufficient replacement parts and backend Soviet technology support.

The security threat environment in 1985-1989 was low. Chinese policymakers correctly perceived the Soviet Union to be distracted in Afghanistan and Eastern Europe. China continued

[17] The carrier was initially purchased for $1.7 million in 1985 for scrap metal. Australia removed the vessel's weapons systems and communications equipment but left the steam catapults and arresting gear. The vessel was not officially scrapped until the late-1990s.

to enjoy stability until the Tiananmen Square protests in June 1989. The international reaction to the crackdown was mostly political, with no mobilization of forces in response. However, China's heavy-handed response to the protests had a long-term impact on the region's stability and cross-strait relations with Taiwan. Furthermore, the evolving dissolution of the Soviet Union removed the largest strategic threat to the Chinese homeland. China's biggest regional concern at this time was the rapid growth of the Japanese economy and whether or not its rise might ultimately facilitate changes to Japan's post-war pacifist constitution. However, as Table 4.6 demonstrates, Japan's growing economic strength did not directly challenge China's position in terms of national capabilities.

Table 4.6: 1987 CINC Top 5

Country	Rank	CINC	T5 Prop.
USSR	1	16.8%	32.5%
US	2	13.1%	25.4%
China	3	10.6%	20.6%
India	4	5.7%	11.0%
Japan	5	5.4%	10.4%

Supply Variables

Military industrial capacity in 1985-1989 was low. China's limited GDP of $271 billion restricted the state's ability to invest in arms development and procurement. Reprioritization of state economic goals forced a large drop in defense expenditure, down to an annual average of $12.5 bn for the period. Military R&D expenditure remained constant at $500 million per year, with the majority dedicated to nuclear weapons and strategic rocket systems. High-technology exports (as % of manufactured exports) were also limited; however, there is little data available to evaluate for this period.

Human capital further constrained China's military industrial capacity as tertiary education slightly improved to only 3.2 percent. Secondary education enrollment rose marginally to just below 40 percent by 1989. During this period, most education investment was concentrated towards improving primary and secondary education, coinciding with the migration of workers in rural communities towards the coastal areas. However, public expenditure for all education levels remained constant at 1.8 percent of GDP in 1987. China continued to reform the military by reducing its budget and overall force structure, including reducing 500,000 personnel. Likewise, in an effort to better centralize planning, the eight defense ministries were consolidated into four ministries in 1988.

Foreign supply of MWS in 1985-1989 was low. China's access to arms suppliers remained limited and military obsolescence steadily rose as a result of the Soviet arms embargo. On the other hand, a stable security threat environment enabled China to implement deeper defense reforms and invest in its economy. While the Soviet embargo was detrimental to large-scale arms acquisition, Western states sold limited arms and subsystems to China. The Peace Pearl Project with the US came into fruition in 1986 resulting in substantial financial and technological assistance in certain Chinese arms projects, notably the J-8 fighter aircraft program. Similarly, France, Britain, and Germany provided newer sub-systems for license and direct transfer, including Spey turbofan engines, gas turbines, ASW sonars, Castor-2 fire-control radars, and diesel tank engines. Unfortunately, these benefits were short-lived. In 1989, PLA forces cracked down on democracy demonstrators in Tiananmen Square resulting in widespread Western condemnation. As a result, the US suspended diplomatic exchanges and weapons exports. Most European states voluntarily joined the arms embargo in 1989.[18] As a result of this reversal, China found itself once again technologically isolated.

To summarize, the combination of moderate-high military obsolescence and low security threat environment contributed to moderate demand for military modernization. At the same time, low military industrial capacity and low foreign supply resulted in low arms supply. This period represented a continuation of the strategy discussed in Period 1—de-emphasizing military modernization in favor of economic development. While many of the key economic indicators and some of those included under military industrial capacity only changed marginally this period, commitment to the strategy demonstrated the CCP's resolve and belief in the strategy. Some have even speculated that China's leaders foresaw the collapse of the Soviet Union having seen its disfunction up-close, which may have reinforced their perceptions of a low security threat environment. However, this strategy meant that military obsolescence would continue to grow and would need to be addressed at some point. But at this time, military industrial capacity was nowhere near the point of meeting this future demand. Under these conditions, military modernization was low (with a projected estimated value of $6.5 billion for this period).

PERIOD 3: 1990-1994

4.4 Developments in Military Modernization

Table 4.7: Chinese MWS, 1990-1994

Designation	Category	Supplier	Year	Quantity	Projected Estimated Value
Type-053 H1G	Frigate	Indigenous	1993	6	$1,500
Type-053 H2G	Frigate	Indigenous	1992	4	$800
Luda-class	Destroyer	Indigenous	1990	2	$400
Mi-17	Helicopter	USSR	1990	24	$456
Ming-class Type 035G	Submarine	Indigenous	1990	11	$1,800

[18] Part of the modernization project continued briefly until completely suspended by the PLA in 1990.

Luhu-class	Destroyer	Indigenous	1991	2	$860
Type-96	Tank	Indigenous	1991	1,500	$2,100
Su-27S	Fighter Aircraft	Russia	1992	24	$900
AS-350/550 Fennec	Helicopter	France (L)	1992	55	$130
IL-76M	Transport Aircraft	Russia	1992	10	$200
Su-27UBK	Fighter Aircraft	Russia	1992	2	$92
Kilo-class	Submarine	Russia	1993	4	$1,400
Song-class Type-039	Submarine	Indigenous	1993	1	$250
Total:					**$11,000**

(L) – Denotes leased item from supplier

As shown in Table 4.7, China's military modernization in this period consisted of four key developments. During this period China's armed forces made advancements in: (1) fighter aircraft; (2) naval destroyers and frigates; (3) submarines; (4) main battle tanks; and (5) transport aircraft.

In terms of fighter aircraft, the PLA procured 20 single-seat Su-27SKs and six twin-seat Su-27UBKs in 1992, making China the first non-CIS country to operate the advanced fighter. The Su-27 was designed as an air-superiority fighter intended to challenge Western third-generation fighters such as the F-14 and F-15. As a result, the fighter can only perform secondary ground attack missions with "dumb" munitions.[19] Despite its limited range the aircraft does possess advanced avionics and radar enabling the fighter to track up to ten targets, including surface targets.

In terms of naval destroyers, the PLAN commissioned the first two combatants in its new Luhu-class (Type-052). Designed as a multirole missile destroyer, the ships are considered to possess comprehensive surface strike, air defense, and ASW capabilities. The Luhu-class is also the first to incorporate multiple Western armaments and sensors, the integration of which delayed sea trials for three years. The destroyers were also the first to be equipped with the YJ-

[19] Such limitations were magnified by the Gulf War and interventions in the Balkans demonstrating the increasing effectiveness of precision-guided munitions.

83 sea-skimming anti-ship cruise missile housed in four quadruple launchers on deck. In addition, the destroyers possess the French Thales Crotale short-range SAM system. Furthermore, the PLAN commissioned the final two Luda-class destroyers with improved radar, C3I systems, and 8-cell HQ-7 SAM launchers. Likewise, older variants of the Luda-class began modernization refits, adapting them with more advanced ASW and air defense capabilities. It also obtained two variants of its Type-053-H frigate.

In terms of submarine capabilities, the PLAN introduced two new platforms into its fleet and expanded its fleet of Ming-class diesel-electric attack submarines. In 1993, China ordered four Kilo-class diesel-electric submarines from Russia, a deal worth $750 million at the time (the latter two were the improved Project 636 variant). The four boats were delivered between 1995 and 1998. The Kilo represented China's most advanced attack submarine (it was also the most exported submarine in the world). The Project 636 variant had more powerful and efficient diesel generators, enabling the boat to operate 45 days at sea. Combined with rubber anti-sonar tiles, the boat provided a substantial reduction in acoustic signature compared to any other submarine operated by the PLAN. In addition to the Kilo, the PLAN introduced the Ming-class Type 035G eventually building 11 of them. China also launched the prototype for its second-generation indigenously developed diesel-electric attack submarine, designated Song-class (Type-039). The boat, however, experienced severe design flaws and deficiencies resulting in major redesigns, preventing it from becoming operational until 1999 (and subsequently delaying further production). The Song-class incorporates numerous foreign technologies including three German MTU 16V396SE84 diesel engines and French Thomson-CSF underwater sensor suite.

In terms of tanks, the PLA introduced the second-generation Type-96 (ZTZ96) in 1991. Based on the Type-88 series, the Type-96 was better suited for the export market with improved mobility and fire-control. Together, the ISFCS-212 image-stabilized fire-control system, integrated laser rangefinder, computerized ballistics, and stabilized sensors enable the tank to track and engage moving targets while in motion. Despite advancements in composite armor plating, the tank still relied on foreign designs, particularly the 1,000hp engine and autoloader reverse-engineered from Russian platforms. The Type-96 eventually entered service in the mid-1990s, and by 2005, over 1,500 units were produced.

In 2006, a modified variant (ZTZ96G or Type-96G, also called Type-96A) was introduced. The upgraded variant features arrow-shaped spaced add-on armor modules along with explosive reaction armor plates on the front hull and rear of the turret. The G-variant is also among the first PLA tanks to feature a thermal imaging system which is now standard on modern tanks. The Type-96A represented a bridge between the second-generation Type-96 and subsequent third-generation Type-98/99 tanks.

In terms of transport aircraft, the PLA purchased 10 Ilyushin IL-76MDs from Russia throughout the period and had about 14 such aircraft by the late 1990s. The IL-76 is the largest and most capable military transport aircraft in PLA service and fills a critical airlift gap. The heavy-lift transport is capable of carrying 200 troops or three armored vehicles 3,800 miles into enemy zones. The IL-76MD is powered by four D-30KP turbofan engines. One of the units has since been converted into a flying testbed by the China Flight Test Establishment in order to support indigenous engine development programs, including the WS-10A.

4.4.1 Factors Contributing to Military Modernization

China's military modernization in 1990-1994 was influenced by military industrial capacity, foreign supply, military obsolescence, and changes in the security threat environment. These variables can be categorized as demand or supply oriented.

Demand Variables

Military obsolescence in 1990-1994 was high as the PLA continued to face widespread block obsolescence. Furthermore, the Gulf War demonstrated how far the gap in military capabilities between China and the West had grown. The obsolescence of many of China's MWS was on full display throughout the conflict. For example, over 1,000 T-69 tanks supplied by China were destroyed in Operation Desert Storm. The conflict demonstrated many new technologies and their integration into MWS, including night vision, thermal imaging, precision munitions, and networked communications. Thus, military obsolescence had a profound impact on military modernization during this period.

The security threat environment in 1990-1994 was moderate due to international outcry over the Tiananmen Square massacre. As Table 4.8 demonstrates, the collapse of the Soviet Union profoundly impacted the distribution of power. Most importantly, it firmly established the US as the lone superpower and most influential actor in international relations.

The Gulf War caught many PLA leaders off-guard and proved to be a major catalyst for all subsequent defense planning. While the immediate threat to regional instability was low, the gap in capabilities became paramount and the US soon became the PLA's primary threat. According to General Chen Zhou, author of the last four defense white papers, "We studied RMA exhaustively. Our great hero was Andy Marshall in the Pentagon [the powerful head of the Office of Net Assessment who was known as the Pentagon's futurist-in-chief]. We translated every word he wrote."[20] The timing of this revolution provided the PLA with the opportunity to make substantial advances in its capabilities.

Additionally, China's growing economy provided the capability to make it a future rival to the US, in a region where the US had significant strategic and economic interests. Complicating matters more was Taiwanese President Lee Tung-hui intensifying support for independence following democratic reforms early in this period. Furthermore, the US increased its volume of arms sales to Taiwan. During this period, total US arms sales to Taiwan equaled $10.5 (current) billion and included advanced weapons systems such as the F-16 and Patriot air defense missiles.[21] Thus, the dramatic changes in the international system altered the regional distribution of power from one of stability towards increased competition.

Table 4.8: 1992 CINC Top 5

Country	Rank	CINC	T5-Prop.
US	1	14.6%	32.5%
China	2	11.7%	26.1%
Russia	3	6.5%	14.5%
India	4	6.2%	13.9%
Japan	5	5.8%	13.0%

Supply Variables

Military industrial capacity in 1990-1994 was low. China remained committed to economic growth over military modernization as demonstrated by 36 percent GDP growth across the period and limited defense growth. China's GDP reached $424 billion while military expenditure rose modestly for the period for an annual average of $20.2 billion. Benefitting from

[20] *The Economist*, "The dragon's new teeth," April 7, 2012 ed., pp. 28-30.

[21] Shirley A. Kan, "Taiwan: Major U.S. Arms Sales Since 1990," Congressional Research Service (Washington, DC: Congressional Research Service, 2013), p. 55.

the increase in expenditure was military R&D which doubled from the previous period to an average of $1 billion annually.[22] This focus was in line with Deng's emphasis on technology and self-sufficiency. High-technology exports (as % of manufactured exports) in the first period for which data is available in China, accounted for just 6.4 percent. Human capital remained low as tertiary education dropped marginally to 3.0 percent. Lastly, China again restricted its defense industries in an effort to corporatize the industries, reduce redundancies, and decentralize planning. As a result, the four primary defense ministries were reformed into six ministries.[23]

Foreign supply of MWS in 1990-1994 was low-moderate, but two events altered China's access to foreign arms suppliers. First, the Tiananmen Square crisis in 1989 induced a Western arms embargo led by the US that continued into the early 1990s. Second, the collapse of the Soviet Union prompted a massive windfall in surplus Soviet equipment worldwide. China imported over $10 billion worth of surplus Soviet arms during this period, more than any amount the West provided in the previous 10 years. The Soviet arms embargo against China fell along with the Berlin Wall as defense priorities shifted in Russia. Due to a collapsing Russian economy, many former Soviet scientists and engineers sought better opportunities in China and North Korea where their skills were in high demand. Furthermore, the Western embargo likely had the added effect of intensifying China's indigenous arms industry.

To summarize, the combination of high military obsolescence and moderate security threat environment contributed to moderate-high demand for military modernization. At the same time, low military industrial capacity and low-moderate foreign supply resulted in low arms supply. As noted in Periods 1 and 2, China's approach to de-prioritizing military modernization meant accepting higher levels of military obsolescence. What China likely did not

[22] Arnett, *Military Capacity*, pp. 245-249.

[23] Shambaugh, *Modernizing China's Military,* p. 232.

calculate was just how large the gap had grown in military technology with the West, thus dramatically shifting Chinese defense planners' perceptions of technological obsolescence. While the Persian Gulf War and the Western powers did not pose an immediate threat to China, the conflict's demonstration of superior US capabilities influenced PLA thinking as they witnessed a conventional military similarly equipped to theirs get annihilated. This event influenced a shift in China's calculations about opponent capabilities to cover not just immediate regional neighbors but also global powers. As a result, China doubled defense R&D spending and pursued Russian arms supplies to not only offer a stopgap against military obsolescence but also to likely copy and serve as a foundation for re-invigorating military industrial capacity. Under these conditions, military modernization was moderate (with a projected estimated value of about $11 billion for this period).

PERIOD 4: 1995-1999

4.5 Developments in Military Modernization

Table 4.9: Chinese MWS, 1995-1999

Designation	Category	Supplier	Year	Quantity	Projected Estimated Value
Mi-171	Helicopter	Russia	1995	35	$665
Su-27S	Fighter Aircraft	Russia	1995	52	$1,560
Type-053H3	Frigate	Indigenous	1998	10	$2,000
Y-8J	ASW Aircraft	Indigenous	1996	6	$180
Su-27S/MK /J-11	Fighter Aircraft	Russia (L)	1996	140	$2,000
Type-051B	Destroyer	Indigenous	1996	1	$350
KJ-2000	AWACS Aircraft	Indigenous	1997	4	$160
JH-7	Attack Aircraft	Indigenous	1998	60	$1,200
Song-class	Submarine	Indigenous	1998	2	$500
Varyag/Liaoning	Aircraft Carrier	Russia	1998	1	$20
Sovremenny-class	Destroyer	Russia	1999	2	$1,000
Su-30MKK	Fighter Aircraft	Russia	1999	38	$2,000
Total:					**$12,000**

(L) – Denotes item leased from supplier

China’s military modernization in this period consisted of three key developments as shown in Table 4.9. During this period China’s armed forces made advancements in: (1) fighter aircraft; (2) naval vessels such as destroyers and frigates; and (3) aircraft carriers.

In terms of fighter aircraft, the PLA acquired both the Su-27 and Su-30 multirole fighters from Russia. In 1996, the PLAAF brokered a deal to co-produce the Su-27SK as the J-11. The deal, worth $2.5 billion, was intended to provide the PLAAF with 200 of these aircraft. Russia would continue to supply the avionics and AL-31F turbofan. Even more importantly, the co-production would provide China with valuable knowledge and technology on the development and manufacturing of modern aircraft. Despite the aircraft’s ability to compete with most Western competitors, it still has some major drawbacks, particularly the inability to use advanced precision-guided munitions. In 2004, licensed production of the J-11 ceased after just 100 units were produced. Since then, China fully reverse-engineered and indigenized the Su-27 and adapted it into the J-11B. This upgraded variant of the Su-27/J-11 became the primary fighter for the PLAN’s first aircraft carrier.

This capability shortfall prompted the PLAAF to purchase 38 Su-30MK multirole fighter aircraft in 1999 (delivered in 2000-2001), with an additional 38 in 2001. The Su-30MK became the single most advanced and capable aircraft in the PLA’s arsenal. The Su-30MKK is a direct descendent of the Su-27 program, sharing many of the same designs and turbofan engine. The Su-30, however, is true multirole aircraft with both beyond-visual-range air-to-air and precision strike capabilities. The aircraft is also equipped with the Russian Vympel R-77 MRAAM. Recent variants of the aircraft include the capability to launch long-range supersonic anti-ship missiles. In addition, the aerial refueling capability gives the aircraft an extended range of 1,600km up to 3,500km.

China also ordered and inducted JH-7 attack aircraft, which it had developed in prior years.[24]

In terms of naval destroyers, the PLAN purchased two unfinished Sovremenny class (Project 956) missile destroyers from Russia. Designed as a counter to the US Aegis missile cruisers in the 1980s, the Sovremenny class destroyer exceeded anything produced by the PLAN at the time. With higher displacement and endurance, the ship represents a sizeable improvement in overall combat potential. In addition, the ships are armed with eight 3M-80E Moskit supersonic, sea-skimming anti-ship cruise missiles (ASCMs), capable of attacking surface targets 120km away at a speed of Mach 2.5. The destroyers also feature two single air defense missile launchers armed with 9M38 medium-range air defense missiles. Furthermore, the destroyers possess much improved electronic countermeasures (ECM) and C3I systems over any PLA developed platform.[25]

In addition to the Sovremenny class destroyers, the PLAN also launched one Type-051B indigenously developed multirole missile destroyer. At the time, the Type-051B was the largest surface combatant ever built by China, garnering significant international attention. It was the first to incorporate sloped hull features to reduce radar cross-section and infrared reduction devices. Despite an initial intent to incorporate vertical launch systems, the ship retained the above-deck eight-cell HQ-7 short-range SAM. A second hull was subsequently cancelled during construction.

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[24] This aircraft was conceptualized as a two-seat ground attack plane with missions similar to the American F-111, Anglo-French Jaguar, Soviet Su-24, or European Tornado. A prototype made its first flight in 1988, and some preproduction aircraft entered the air force in the early 1990s.

[25] This includes a Fregat-MAE air search radar, MR-184E and MR-123-02 fire control radars, 3M-80E and MR-90 Orekh air defense guidance systems, PK2/PK10 chaff launchers, MGK-335 sonar suite, and laser warning receivers.

In terms of aircraft carriers, China purchased the unfinished Soviet-era Varyag from Ukraine in 1998 for $20 million.[26] In prior years, the PLA made multiple trips to Russia, Ukraine, and the US to study carrier designs and production.[27] The US trips included visits aboard Nimitz-class carriers. Prior to the Varyag acquisition, China had also purchased three retired aircraft carrier hulls, which were either scrapped or turned into amusement parks, but possibly provided research and design input.[28] The vessel arrived in the Dalian shipyard in 2002 and in subsequent years underwent a comprehensive refurbishment until 2010 when systems installation began. The Varyag (renamed Liaoning or Type 001) is a 60,000-to-65,000-ton vessel featuring the short-takeoff ski-jump launch system. The aircraft carrier completed its refit and began sea trials in 2012 when it was commissioned into the PLAN; it was reportedly combat ready by 2016.

4.5.1 Factors Contributing to Military Modernization

China's military modernization in 1995-1999 was influenced by military industrial capacity, foreign supply, military obsolescence, and changes in the security threat environment. These variables can be categorized as demand or supply oriented.

Demand Variables

Military obsolescence in 1995-1999 was high. The growing economy and a reformed industrial base were not yet contributing value-added capabilities. The PLA faced large-scale

[26] A Macau-based Chinese front company purchased the carrier under the auspice of turning it into a floating casino.

[27] Fisher, *China's Military Modernization*, pp. 184-188.

[28] These include the HMAS Melbourne from Australia (1985), and the ex-Soviet Minsk and Kiev from Russia (1995).

deactivations of aircraft and naval ships. Several platforms that were supposed to be retired in the 1980s could no longer be maintained or modernized further. For instance, 3,000 J-6 (MiG-19) interceptors produced since 1961 would be systematically deactivated and scrapped by the end of the period.[29] Likewise, the PLAN began decommissioning 45 Romeo-class diesel-electric attack submarines which first entered service in 1959. Finally, neither the PLAN nor the PLAAF had any capabilities technologically comparable to those of the US. The PLA, as a whole, lacked the ability to conduct networked joint operations and deliver precision-guided munitions.

The security threat environment in 1995-1999 was high as cross-strait tensions with Taiwan escalated quickly in 1995. During the early 1990s, the Taiwanese government took several steps towards independence. President Lee Teng-hui's visit in May 1995 to Cornell University and pro-independence comments instigated instant Chinese condemnation of Lee and US policy. Beijing responded aggressively with a series of missile tests off Taiwan. In addition, the PLA mobilized thousands of soldiers and arms in Fujian. The US responded by sending two aircraft carrier battlegroups into the South China Sea. Despite Beijing's attempt to influence Taiwanese elections in spring 1996, President Lee was overwhelmingly re-elected. The crisis had a long-term effect on diplomatic relations and became the basis of China's "anti-access" military strategy.[30] A second incident further escalated tensions in 1999 when US-led NATO accidentally bombed the Chinese embassy in Belgrade during a campaign against Yugoslavia. Though deemed a targeting accident, many Chinese policymakers viewed the bombing as deliberate, which sparked anti-US demonstrations across China. Likewise, some scholars have argued that

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[29] Some reports suggest that some J-6s are being converted into UAVs.

[30] Robert S. Ross, "China's Naval Nationalism: Sources, Prospects, and the U.S. Response," *International Security* Vol. 34, No. 2 (Fall 2009), pp. 46-81.

the bombing was a seminal moment in Chinese defense planning since it underscored China's vulnerability.[31]

Additionally, China closed the gap in national capabilities with the US. As Table 4.10 shows, China actually surpassed the US in the CINC.[32] As mentioned above, the Chinese economy grew at or above 10 percent each year and military expenditure grew 150 percent.

Table 4.10: 1997 CINC Top 5

Country	Rank	CINC	T5 Prop.
China	1	14.2%	31.1%
US	2	14.0%	30.6%
India	3	6.5%	14.2%
Japan	4	5.6%	12.3%
Russia	5	5.4%	11.8%

Supply Variables

Military industrial capacity in 1995-1999 was moderate due to progress on multiple fronts. First, China's GDP grew to $958 billion with an average of 10 percent growth. Second, military expenditure rose by 25 percent to an average $25 billion annually, nearly doubling over a decade. Third, military R&D doubled to $2 billion annually. This increase was associated with the PLA's research into MWS and expanding its foundation for modernization. Fourth, high-technology exports (as % of manufactured exports) rose to a moderate level at 13.1 percent demonstrating significant growth in China's technology industry. However, human capital remained low as tertiary education remained stagnant at 5.5 percent in 1997. Secondary enrollment on the other hand rose to above 58 percent by 1997, an increase of 14 percent in a

[31] See for instance Tai Ming Cheung's interview in Sam Roggeveen, "China's really big military R&D effort," *The Interpreter*, October 8, 2013; and Gregory J. Moore, "Not Very Material but Hardly Immaterial: China's Bombed Embassy and Sino-American Relations," *Foreign Policy Analysis* 6, No. 1 (2010), pp. 23-41.

[32] This score is inflated due to several of the indicators being fueled by major increases in consumption (steel, energy, etc.) as a part of industrialization, compounded by China's large population.

few years. Furthermore, China's tertiary institutions produced disproportionately more natural science degrees than its Western counterparts, thus providing an adequate talent pool not demonstrated by the World Bank data. Lastly, China implemented several major military reforms to overcome the failed approaches in prior periods. In 1998, Jiang Zemin instituted sweeping reforms to improve R&D and competition. The General Armament Department (GAD) was created as a central oversight body to supervise the entire military industrial complex, including the supervision of R&D and arms production across six MMBs. COSTIND was again reconfigured and placed under the supervision of the State Council. Third, five of the six ministerial-level arms corporations were expanded into ten with greater specialized roles. The PLA was also ordered to divest its business interests and comply with stricter accountability. Along with these changes, the PLA cut an additional half-million personnel from its ranks. Each of these moves reinforced Jiang Zemin's doctrinal shift towards "integrated joint operations" by the mid-2000s. According to one observer, this shift represented a "revolution in doctrinal affairs."[33]

Foreign supply of MWS in 1995-1999 was low-moderate as China continued to benefit from Russian arms sales. While the Western arms embargo remained in effect, China's improving economy enabled the PLA to purchase greater quantities of Russian arms than before, including the Kuznetsov-class aircraft carrier Varyag. This was further aided by Russia's need to save its defense industrial base which suffered from low international sales and low domestic investment. While finished MWS remained off the board, China's expansion of production agreements with foreign companies to acquire dual-use equipment and technology increased.

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[33] David M. Finkelstein, "Thinking About the PLA's 'Revolution in Doctrinal Affairs,'" in James C. Mulvenon and David M. Finkelstein, eds., *China's Revolution in Doctrinal Affairs: Emerging Trends in the Operational Art of the Chinese People's Liberation Army* (Alexandria, Va.: Center for Naval Analyses, 2005), pp. 1–28.

According to one report, China negotiated 22 agreements with mostly Western aerospace companies to acquire technology and production capabilities.[34]

To summarize, the combination of high military obsolescence and high security threat environment contributed to high demand for military modernization. At the same time, moderate military industrial capacity and low-moderate foreign supply resulted in moderate arms supply. By this point, China's military obsolescence had reached critical levels, which combined with a renewed calculus of the security threat environment drove demand for overhauling the PLA. With this demand, China again doubled defense R&D spending and implemented major defense policy reforms, restructuring both the PLA and the defense industries. Interestingly, China purchased its second aircraft carrier under false pretenses which, unknown at the time, was intended to be a critical investment in building military industrial capacity for carriers in later years. China continued to take advantage of access to surplus Russian and former Soviet states' MWS which almost certainly then integrated with military industrial capacity programs. Under these conditions, military modernization was moderate (with a projected estimated value of about $12 billion for this period).

PERIOD 5: 2000-2004

4.6. Developments in Military Modernization

Table 4.11: Chinese MWS, 2000-2004

Designation	Category	Supplier	Year	Quantity	Projected Estimated Value
Type-98/99A	Tank	Indigenous	2000	200	$380
Type-052C	Destroyer	Indigenous	2000	2	$1,100
Type-052B	Destroyer	Indigenous	2002	2	$1,100
J-8C/D/F	Fighter Aircraft	Indigenous	2000	100	$2,400
Ming-class Type	Submarine	Indigenous	2000	5	$750

[34] Bates Gill and Taeho Kim, "China's Arms Acquisitions from Abroad: A Quest for 'Superb and Secret Weapons,'" SIPRI Research Report, No. 11 (1995), pp. 87-90.

035B					
Mi-17-V5	Helicopter	Russia	2001	35	$665
Su-30MKK	Fighter Aircraft	Russia	2001	38	$2,000
Kilo-class	Submarine	Russia	2002	8	$2,000
Sovremenny-class	Destroyer	Russia	2002	2	$1,400
KJ-20	AWACS Aircraft	Indigenous	2002	3	$100
Shang-class Type 093	Submarine	Indigenous	2002	2	$700
Yuan-class	Submarine	Indigenous	2002	1	$280
Su-30MKK2	Fighter Aircraft	Russia	2003	24	$1,000
Song-class Type 039G	Submarine	Indigenous	2000	3	$750
J-10	Fighter Aircraft	Indigenous	2004	300	$8,400
Total:					**$23,000**

China's military modernization in this period consisted of five key developments as shown in Table 4.11. During this period the PLA made advancements in: (1) fighter aircraft; (2) main battle tanks; (3) naval destroyers and frigates; and (4) submarines.

In terms of fighter aircraft, China introduced the indigenously built single-engine Chengdu J-10 in 2003 after being in development for 18 years. The J-10 is a fourth-generation fighter comparable to the American F-16 and Swedish Gripen. With a relatively low per-unit price of $28 million, the J-10 became one of the main fighters of the modern PLAAF, with about 450 such aircraft in service in the subsequent decade.[35] Development on the J-10 began in the mid-1980s at the Chengdu Aircraft Design Institute shortly after the Soviet Union unveiled the MiG-29 and Su-27. The program emerged from the abandoned J-9 program which was cancelled in 1980. The subsequent J-10 received significant foreign assistance from Russia, Israel (from the cancelled Lavi program), and Pakistan (which provided demonstrations and technology from American F-16s). Assistance from Israel was sizeable and may have included a full Lavi

[35] Lucy Hornby, "China air force woos allies with J-10 fighter jet," *Reuters*, April 13, 2010.

prototype equipped with an American F-100 engine.[36] In addition, Israeli engineers provided guidance on fly-by-wire technology and cockpit instrumentation. In 2001, China ordered 300 AL-31 engines from Russia with subsequent additional orders.

In addition, the PLAAF acquired its third batch of Su-30s, 24 units of the upgraded MKK2 variant. This variant features improved precision-strike capability and a new advanced C4ISR and target acquisition system. The new N001VEP fire-control radar is specifically designed to fire the improved Kh-31 supersonic anti-ship missile. The aircraft operated in the Naval Aviation 4th Division, at Feidong Air Base, opposite Taiwan.

In terms of main battle tanks, the PLA introduced the Type-98 that was renamed the Type-99 (ZTZ99). (Eventually, three versions of the Type-99 were deployed: the Type-98 considered a prototype, the Type-99, and the Type-99A).[37] With a $2 million per unit price, the Type-99 is a third-generation main battle tank featuring improved composite armor plating, improved thermal imaging, and upgraded electro-optical countermeasures. The need for an improved tank was realized following the Gulf War since current tanks were proven little match for Western tank designs such as the Abrams M1A1. In the 2000s, the advanced T-99 only served in elite armor regiments in the Shenyang Military Region (Beijing), but it was subsequently produced in greater numbers in the next time periods.

In terms of naval destroyers, the PLAN commissioned some new indigenous ships and procured two more Sovremenny class destroyers from Russia. The indigenously developed and built ships represented new classes of warship in China's growing naval fleet. The PLAN launched two Type-052B multirole missile destroyers in 2002-2003, and both were

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[36] Jake Collins, "Chinese Fighter Evolution," *Air Forces Monthly*, October 2001, pp.54-55.

[37] The Type-98 was China's version of the Soviet Type-90, and was first seen at the time of the 1999 National Day parade. The Type-99A was initially tested around 2007 and officially introduced at the 2015 Victory Day Parade.

commissioned by 2004. This vessel incorporates increased Russian content and armaments, thus enhancing its combat capabilities over previous Chinese-built vessels. The Type-052B's primary mission is anti-surface and anti-submarine operations. The destroyer's design is significantly influenced by the Russian Sovremenny-class destroyer. Likewise, the vessel features many Russian weapons systems, including the 9M317 Shtil medium-range air defense missile, MR90 SAM fire-control radar, Fregat-MAE-5 3D air/surface search radar, and Mineral-ME ASCM supporting data-link. Furthermore, the 052B is powered by two Ukraine-made DA80/DN80 gas turbines, an improvement over the older steam power plant used in previous Chinese-built vessels.

Finally, the PLAN also launched the Type-052C missile destroyer in 2003 (two were launched in 2003 and commissioned in 2004 and 2005, and four more were launched in 2010-12). Similar to the 052B in hull design, the vessel features a different weapons configuration with significantly more indigenous weapons systems. These systems include a four-array multifunction phased array radar comparable to the American Aegis system, the indigenous HQ-9 air defense missile system (reverse-engineered from the Russian S-300F/Rif), and the YingJi-62 anti-ship cruise missile. The destroyer is believed to include a new indigenous command and control system, improving upon the French Thomson-CSF TAVITAC influenced system of the 1980s. The Type-052C was considered the most complete air defense surface combatant in the PLAN.

In terms of submarine capabilities, the PLAN launched or purchased many new submarines across different classes. Three of these classes represented newly developed platforms while the other three were supplemental orders. Eight of these new submarines were a second order of Kilo class diesel-electric attack submarines from Russia. The $1.5 billion deal was signed in 2002 with delivery completed between 2005 and 2007. This second block, however, was the improved Project 636M submarine equipped with the Klub-S anti-ship cruise missile system. In addition to the Kilo, the PLAN completed the final two hulls in the Ming-class diesel-electric attack submarine, for a total of 20 active boats in its class. In 2001, the PLAN overcame prior design flaws in the Song-class diesel-electric attack submarine experienced in Period 4. As a result, three new hulls were launched.

China's advancements in submarine technology and capabilities are demonstrated by the introduction of the Yuan, Shang, and Jin-class submarines. The Yuan-class is diesel-electric powered but is the first Chinese submarine to incorporate the advanced air-independent propulsion (AIP) system, which enhances underwater performance and allows the submarine to stay submerged for weeks. As a result of the added stealth features, on top of rubber anti-sonar tiles around the hull, the submarine is tactically flexible and dangerous to opposing vessels. The class represents a combination of indigenous designs and Russian influence, particularly from the Kilo. The two additional Shang-class submarines are second-generation (following the Han-class developed in the 1970s) nuclear-powered attack submarine. Development on the Shang-class began in the mid-1980s but with little progress until Russian assistance was provided a decade later. While details of the class remain secret, it is believed according to some reports that the Shang is comparable to early variants of the US Los Angeles class SSN, but inferior to the Seawolf and Virginia-class.[38] Finally, although this dissertation does not cover strategic nuclear forces, it should be noted that the PLAN launched the first hull in its second-generation nuclear-powered ballistic missile submarine (SSBN), replacing the lone Xia-class hull launched in 1983. Development of the Jin-class began around 1990 with assistance from the Rubin Central Design Bureau for Marine Engineering in Russia. The submarine carries 12 ballistic missiles, such as the

[38] Dave Makichuk, "Run silent, run deep: Shang-class subs prove stealthy," *Asia Times*, April 28, 2020.

JuLang-2 SLBM, a three-stage solid propellant strategic ballistic missile derived from the land-based DongFeng-31 intercontinental ballistic missile (ICBM).

4.6.1 Factors Contributing to Military Modernization

China's military modernization in 2000-2004 was influenced by military industrial capacity, foreign supply, military obsolescence, and changes in the security threat environment. These variables can be categorized as demand or supply oriented.

Demand Variables

Military obsolescence in 2000-2004 was high as several 1950s and 1960s-era MWS remained in use. Widespread decommissioning of MWS began in the early 1990s, slowly accelerating until 2000. By the end of Period 5, over 40 submarines, five principal surface combatants, 2,000 aircraft, and 3,000 tanks were decommissioned or placed into reserve.[39] Likewise, the PLA began another round of demobilizing which began in 1998 and continued thereafter, resulting in a reduction of another 500,000 personnel. As a result of these changes, the overall structure of the PLA began to change significantly, with greater emphasis on modernizing air and naval capabilities. In addition, US operations in Afghanistan and Iraq provided another round of demonstration of the state-of-the-art in weapons capability and strategy. These operations were pivotal to PLA planners who carefully studied the expansion of Western capabilities. In particular, they observed the value of space-based capabilities and platforms that enabled or enhanced power project such as aerial refueling tankers. As a result of

[39] This also includes the PLAN's first two nuclear attack submarines (Han-class), which were decommissioned in 2000 and 2001, respectively. The remaining three Han class submarines received their mid-life refits in 1998, but will likely require replacement by 2020.

these changes in force structure and military technology, military obsolescence played a significant role in military modernization during this period.

The security threat environment in 2000-2004 was moderate-high, improving marginally from the period before. The high tensions experienced in the aftermath of the Third Taiwan Strait Crisis in 1995-1996, were tempered by the events of September 11, 2001.[40] The US war on terror had three lasting effects on US-China relations. First, it took the center stage in the international security arena, thus relegating to the background prior controversial incidents such as the April 2001 Hainan Island incident, in which a US Navy EP-3E ARIES II signals intelligence aircraft collided with a Chinese fighter jet. The EP-3E was forced to land on Hainan island and created a major international diplomatic crisis. Second, the US war in Afghanistan and then Iraq shifted the international community's focus from East Asia to the Middle East and South Asia. Third, these wars created a diplomatic window for China to improve relations with European states and increase in high-technology imports and licensing. China further enhanced its position through high economic growth and increased military expenditure. As Table 4.12 demonstrates, these national indicators enhanced China's position vis-à-vis the US as reported by the CINC. This phenomenon of competition between the two powers was further aided by economic recession in the US. At this time, however, India began experiencing major economic growth and renewed emphasis on military modernization. As a result of these developments, the security threat environment played an important role influencing Chinese military modernization.

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[40] Sino-US tensions were heightened again in April 2001 following the mid-air collision between a US Navy EP-3E ARIES II spy plane and a Chinese J-8II fighter jet off the coast of Hainan Island. The Chinese pilot was killed while the US spy plane was forced to make an emergency landing on the island. The incident resulted in an unfortunate diplomatic row at the onset of President George W. Bush's administration thus complicating any new Sino-US rapprochement.

Table 4.12: 2002 CINC Top 5			
Country	**Rank**	**CINC**	**T5 Prop.**
China	1	16.7%	34.9%
US	2	14.3%	30.0%
India	3	6.9%	14.5%
Japan	4	5.1%	10.7%
Russia	5	4.8%	9.9%

Supply Variables

Military industrial capacity in 2000-2004 was moderate. China's GDP grew to $1.5 trillion thus enabling higher military expenditure and other investment into military industrial capacity. Military expenditure grew by over 80 percent to an average $46.4 billion annually. Subsequently, military R&D doubled again to $4 billion annually. This increase was associated with the PLA's research into MWS and expanding its foundation for modernization. High-technology exports (as % of manufactured exports) rose significantly to 23.7 percent demonstrating significant growth in China's technology industry. In terms of human capital, tertiary education enrollment grew to a moderate level of 17.4 percent by 2004, demonstrating the government's efforts to transform its labor force. Likewise, secondary enrollment rose 10 percent to 64.4 by 2002. Fueling much of this increase in tertiary enrollment was an increase in the number of domestic institutions as well as a spike in students studying abroad, especially in the US. Lastly, China introduced no new major MIC reforms and instead continued to implement the reforms introduced in 1998.

Foreign supply of MWS in 2000-2004 was moderate as China continued to benefit from Russian arms sales and as cracks formed in the Western arms embargo, opening the door to various dual-use products and technologies. In particular, European states like Germany, France, and Italy exported various dual-use products to include advanced avionics, radars, optical sensors, and sonar systems. Part of this splitting of the arms embargo may have been driven by globalization of the arms industry throughout the 1990s and early 2000s. Major defense contractors became increasingly concerned with exporting components. At the same time, China often misconstrued its applications of many dual-use products to hide the true end-use, PLA weaponry. In addition, China expanded its civilian absorption of foreign companies and technology. To accomplish, China established complex and coercive programs driven by national development goals as a condition of for market access.[41] For example, in 2003, the creation of the Medium- and Long-Term Plan for Science and Technology Development (known as MLP) set the standard for acquiring and controlling international intellectual property and standards to exploit global supply chains and dual-use technologies.[42] Subsequent Five-Year Plans expanded on this initiative before culminating in grand policies like *Made in China 2025* and *S&T Innovation 2030* project. During this period in particular, China leveraged wholly foreign owned enterprises (WFOE), and to a lesser extent joint ventures, to attract foreign direct investment in manufacturing, the gateway for coercing intellectual property transfer at later stages.[43] Thus, despite limited available foreign suppliers of finished MWS, China managed to subvert this limitation by exploiting loop-holes in dual-use technologies (or in some cases poorly monitored dual-use technologies) and coercive foreign direct investment programs to indirectly benefit military industrial capacity.

To summarize, the combination of high military obsolescence and moderate-high security threat environment contributed to high demand for military modernization. At the same time,

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[41] Karen M. Sutter, "Foreign Technology Transfer Through Commerce," in William C. Hannas and Didi Kirsten Tatlow, eds., *China's Quest for Foreign Technology: Beyond Espionage* (New York, N.Y.: Routledge, 2021), pp. 57-73.

[42] Ibid, p. 59.

[43] Ibid, pp. 61-64.

moderate military industrial capacity and moderate foreign supply resulted in moderate arms supply. By this point, China's military industrial capacity had improved and priorities for foreign arms supply shifted from filling stopgaps with legacy MWS to seeking out state-of-the-art capabilities like Russia's latest Kilo class submarines and the Su-30 fighter aircraft. While not addressed in detail in this study, this pursuit also included numerous critical subcomponents for MWS, often from European suppliers, such as aircraft engines, avionics, and radars. Overall, the combination of improved military industrial capacity and elevated concerns over the security threat environment had a major impact. For example, China's naval shipbuilding jumped with serial production of at least 11 indigenous submarines. Likewise, the Taiwan situation remained tense under a new US political administration, underscored by the EP-3 surveillance aircraft collision and crisis. Under these conditions, military modernization was high (with a projected estimated value of about $23 billion for this period).

PERIOD 6: 2005-2009

4.7 Developments in Military Modernization

Table 4.13: Chinese MWS, 2005-2009

Designation	Category	Supplier	Year	Quantity	Projected Estimated Value
Y-9	Transport Aircraft	Indigenous	2005	20	$400
Type-054	Frigate	Indigenous	2005	2	$600
Song-class Type-039GI	Submarine	Indigenous	2005	7	$1,750
Z-9	Helicopter	Indigenous	2005	100	$1,500
Type-051C	Destroyer	Indigenous	2005	2	$800
Ka-27/31 Helix	Helicopter	Russia	2006	18	$50
JF-17	Fighter Aircraft	Sino-Pakistani	2006	8	$280
JL-9	Trainer Aircraft	Indigenous	2006	10	$250
Yuan-class Type-039A	Submarine	Indigenous	2006	12	$3,600
Type-99	Tank	Indigenous	2006	200	$500
J-8D	Fighter Aircraft	Indigenous	2007	48	$1,100

JH-7A	Attack Aircraft	Indigenous	2007	100	$3,000
Type-094	Submarine	Indigenous	2007	3	$2,400
Mi-17	Helicopter	Russia	2007	54	$1,000
Type-99/99A	Tank	Indigenous	2007	250	$650
Type-053H	Frigate	Indigenous	2008	2	$700
H-6D	Bomber Aircraft	Indigenous	2008	12	$480
Type 054A	Frigate	Indigenous	2008	4	$1200
Zubr	Amphibious craft	Ukraine	2009	4	$16
Mi-17	Helicopter	Russia	2009	32	$600
Shang-class Type-093	Submarine	Indigenous	2009	3	1,500
Total:					**$23,000**

(L) – Denotes item leased from supplier

China's military modernization in this period consisted of several major developments as shown in Table 4.13. During this period China's armed forces made advancements in: (1) fighter aircraft; (2) transport aircraft; (3) refueling aircraft; (4) transport and attack helicopters; (5) submarines and naval vessels; and (6) main battle tanks.

In terms of fighter aircraft, PLAAF certified production of the J-11B and J-15 and began flight testing on two stealth fighters, the J-20 and J-31. The J-11B is the reverse-engineered copy of the Russian Su-27SK. The Chinese copy, however, features a greater level of indigenous content and enhanced precision-strike capabilities. The PLAAF have successfully developed multifunctional pulse-Doppler fire-control radar, thus giving the aircraft a true multi-targeting capability. China also ordered over a hundred JH-7A (an improved full-scale production model of the JH-7) and the first of these entered service in the mid-2000s.[44]

In terms of transport aircraft, China entered into a contract for 24 Il-76MD planes and four Il-78 tanker versions for $1.5 billion. In terms of aerial refueling aircraft, the PLAAF

[44] Eventually, over 100 JH-7A were service in the late 2010s, split evenly between the naval air force and air force. See Sebastien Roblin, "Meet China's New JH-7A 'Flying Leopard' Supersonic Fighter-Bomber," *The National Interest*, August 17, 2019.

sought four IL-78MDs, which are modified variants of the IL-76 transport.[45] With a maximum transferable fuel load of 233,100 lbs., the IL-78 can simultaneously refuel three aircraft. The introduction of the tanker into the PLAAF was intended to fill a critical gap in combat capabilities, thus enhancing the potential combat radius of smaller attack aircraft. The 2005 order for the Il-76 and Il-78 had not been fulfilled by 2010, because of difficulties at the Tashkent production factory, resulting in China undertaking another order for these aircraft in 2010-2011.

In terms of transport and attack helicopters, the PLA procured over 100 additional Russian Mi-17s in this period and the next period, to augment the 60 obtained in the 1990s, and began serial production of the indigenous Z-10. The majority of the PLA's medium transport helicopter fleet consists of the Russian Mi-17/171s. The 7-ton Mi-17s were one the first arms deals made by China following the collapse of the Soviet Union, due in part to the fact that the US refused to sell it any more Blackhawk helicopters after the Tiananmen Square massacre. The Mi-17 is the backbone of many non-Western armies for its affordability, versatility, and on some variants, rocket launching capabilities; however, at this time the PLA's overall airlift capability remained low and was uncertain how long the fleet of Mi-17s will propel PLA forces, particularly is special operations units.

In 2005, China entered into a joint contract with French Eurocopter to co-develop and co-produce a new medium utility helicopter. The result of this collaboration is the Z-15 which made its initial flight in 2016. The PLA has also been developing an indigenous attack helicopter, and it went on to build about 100 units each of the Z-10 (with a Pratt and Whitney engine) and Z-19 (upgraded from the Z-9) helicopters starting in the subsequent decade.

[45] Vladimir Karnozov, "China Orders Il-76s as It Awaits Il-476s," *Aviation International* News, November 30, 2012.

In terms of submarines, the PLAN launched Song-class, Yuan-class, and one Jin-class between 2005 and 2012, as well as the Shang-class nuclear powered attack submarine. Many of these newer submarines, such as the Ming SSK, incorporate foreign technology assistance from Germany (engines), Israel (electronics), and Russia (design and engineering). These attack submarines possess quieter technology, longer lasting batteries, anechoic tiling, sonar procession, increased automation, and potentially 120-km range anti-ship missiles.[46] The older Romeo SSKs and Ming SSKs were gradually decommissioned.

Reports suggest that submarine construction has expanded to multiple shipyards beyond Wuhan.[47] The PLAN's latest diesel-electric submarine, the Yuan, can stay underwater for up to two weeks. The expansion of its nuclear submarine fleet includes three Shang-class fast attack submarines. In addition, its two Jin-class SSBN submarines were launched in 2004 and 2007. China also seeks to gain from the revival of Russia's nuclear submarine program as it pushes forward on the development of its Severdovinsk-class SSN. Altogether, the expansion of submarine warfare capabilities could pose significant challenges to US fleets operating in the Asia-Pacific region.

In terms of other naval vessels, the Type-051C is an air-defense missile destroyer but also provides considerable anti-submarine capabilities. The ship's primary armament is the Russian built S-300FM Rif-M air defense missile system, equipped with 48 missiles in six launchers. The system uses the formidable 48N6 missile guided by the Volna 3D phased-array radar. China also introduced the Type 054 and 054A frigates in this period.

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[46] Fisher, *China's Military Modernization*, p. 149.

[47] Office of the US Secretary of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China*, 2012 (Washington, D.C.: Department of Defense), p. 32.

In terms of tanks, China continued to produce its third-generation Type-99 and also began testing prototypes of the Type-99A, and both these were produced in greater numbers in this time period and the subsequent time periods.

4.7.2 Factors Contributing to Military Modernization

China's military modernization in 2005-2009 was influenced by military industrial capacity, foreign supply, military obsolescence, and changes in the security threat environment. These variables can be categorized as demand or supply oriented.

Demand Variables

Military obsolescence in 2005-2009 was as high as approximately 60 percent of the PLA force structure was beyond 30 years operability. The fielding of numerous indigenous MWS programs aided the PLA's block obsolescence in this period. For example, the PLAN grew from 52 submarines in 1985 to 64 vessels by 2009. The surface fleet grew from 38 principal surface combatants in 1980 to 78 by 2009. Likewise, the PLA made substantial upgrades in qualitative capabilities compared to its former early-Soviet-era arms. Many of these programs, however, were reverse-engineered Russian arms which did not yet match the Western state-of-the-art. Western observers argue that most Chinese-produced arms remain 10-20 years behind their Western counterparts.[48]

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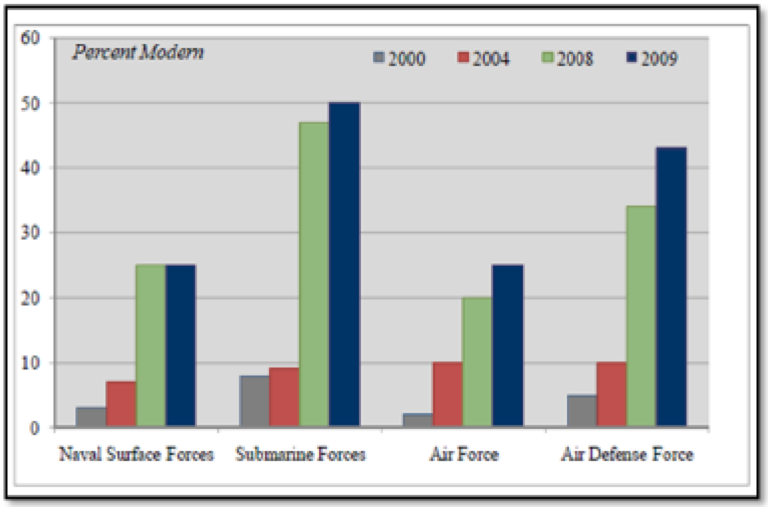
[48] Fisher, *China's Military Modernization*, pp. 66-79.

Figure 4.1: Increase in modern naval vessels within the PLA Navy in 2000, 2004, 2008, and 2009. Numbers for submarines (aggregate for both nuclear and diesel-electric propulsion) are shown in the second column from left.



Source: Office of the Secretary of Defense, 2010 Report to Congress.

The security threat environment in 2005-2009 was dropped to moderate due to China's growing national capabilities and an absence of direct challengers, but regional flashpoints remained. China's perceived stability in the security environment was likely aided by the US's military involvement in Iraq and Afghanistan. China's economic growth and military expenditure rose sharply throughout this period. As a result, China's CINC score (see Table 4.14 below) increased, particularly in relation to its near peers. Combined with these expanding military capabilities and dispute over Taiwan, China's rise attracted concerns about its future interests in the region. Tensions over China's ambitious claims in the South China Sea began to reveal signs of looming instability in the region. In particular, competition over the Senkaku/Diaoyu islands near Japan and the Scarborough Shoal near the Philippines intensified, frequently resulting in mobilization of aircraft and warships.[49] Furthermore, US foreign policy identified East Asia as its top strategic interest as it looked to withdraw from the Middle East and South Asia.[50] As a result of the US rebalancing, which was officially announced in the early 2010s, China dedicated a significant amount of its military modernization towards neutralizing and deterring American forces in the region.[51]

Table 4.14: 2007 CINC Top 5			
Country	**Rank**	**CINC**	**T5-Prop.**
China	1	19.9%	40.0%
US	2	14.2%	28.7%
India	3	7.3%	14.8%
Japan	4	4.3%	8.6%
Russia	5	3.9%	7.9%

Supply Variables

Military industrial capacity increased to high this period due to major progress in the economy and scientific inputs. China's GDP grew to $4.6 trillion thus enabling higher military expenditure and other investment into military industrial capacity. Military expenditure grew by over 80 percent to an average of $88.4 billion annually. Subsequently, military R&D doubled again to $8 billion annually.[52] High-technology exports (as % of manufactured exports) rose marginally to 25.6 percent demonstrating maturity in China's technology industry.

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[49] See for instance Michael Mazza, "South China Sea Festers," *The National Interest*, September 18, 2013.

[50] Hillary Clinton, "America's Pacific Century," *Foreign Policy*, October 11, 2011.

[51] Anthony H. Cordesman and Nicholas S. Yarosh, "Chinese Military Modernization and Force Development: A Western Perspective" (Washington, DC: Center for Strategic and International Studies, 2012), pp. 32-45.

[52] China's military R&D calculation from this period and beyond is based on expert analysis that in the early 2000s China increased its R&D spending from an approximate standard of 5 percent to between 8

Human capital grew significantly as tertiary enrollment rose to a moderate level of 20 percent, demonstrating major improvement in China's education system as well as the increase in Chinese students studying abroad. In less than a decade, tertiary enrollment doubled while Chinese students became the largest group of foreigners to study in the US. Likewise, the ratio of Chinese students pursuing STEM degrees compared to any other program was four-to-one.[53] By 2005, 52,000 graduates of the SASTIND affiliated program went on to work for the defense industry, representing 18 percent of total graduates during that period, thus demonstrating the tremendous impact of changes in China's human capital on military industrial capacity.[54] Over one-third of those students were post-graduates, representing the rising innovative and research-oriented capacity of its talent pool. Furthermore, China established the Thousand Talents Plan in 2008 as a means of attracting international experts in various areas of science and engineering.

After absorbing and mastering the technology and knowledge transfers that the Russians provided for the Su-27 aircraft, China commenced the illicit reverse-engineering of the Su-27, which they renamed the J-11B.[55] The J-11B is reportedly a "generational improvement over the Su-27 with the addition of new capabilities such as a reduced radar cross-section, improved fire-control radar, wide use of composite materials, a new flight control system, a digital glass cockpit, and a Chinese-developed engine."[56]

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and 10 percent. This study uses the median 9 percent estimate. See for instance Tai Ming Cheung's interview in Sam Roggeveen, "China's really big military R&D effort," *The Interpreter*, October 8, 2013.

[53] U.S. Department of Education, Annual Report to Congress, Fiscal Year 2012 (Washington, D.C.: Department of Education).

[54] Tai Ming Cheung, "The Chinese Defense Economy's Long March from Imitation to Innovation," *Journal of Strategic Studies* Vol. 34, No. 3 (2011), pp. 337.

[55] Ibid, pp. 328-329.

[56] Ibid, p. 329.

Furthermore, China's military industrial capacity was aided by emphasis on R&D reform. In 2007, COSTIND issued a report detailing six R&D priorities in a 15-year plan:[57]

1. Promote the corporatization of R&D institutes
2. Accelerate the transformation of public research institutions
3. Expand defense laboratories and testing facilities
4. Improve management and coordination of scientists and defense projects
5. Establish general S&T fund
6. Require defense firms to invest 3 percent of sales into R&D

While many R&D laboratories existed since the late-1980s, most lacked the funding to operate above maintenance and personnel. By 2008, China began increasing R&D funding to adequate levels and closing underperforming laboratories.[58] Thus, the expansion of R&D and tertiary education contributed significantly to increased military industrial capacity during this period.

Foreign supply of MWS in 2005-2009 was low as Russia reduced the range of MWS it was willing to sell to China and the West maintained a loose embargo on MWS; however, the expansion of dual-use licensing deals and its acquisition of foreign technology companies grew significantly (see Figure 4.2 in Period 7 below). This back-door strategy, coupled with systemic economic espionage, greatly influenced China's domestic arms industry.

To summarize, the combination of high military obsolescence and moderate security threat environment contributed to moderate-high demand for military modernization. At the same time, high military industrial capacity and low foreign supply resulted in moderate arms supply. For the first time since the early 1990s, China's security threat environment was not elevated to a high level though was still moderate. China's growing military industrial capacity continued to fuel indigenous production of MWS. Meanwhile the nature of Russia's arms supply to China changed. Various open sources began to reflect Russia's concerns over Chinese reverse-

[57] "Summary of the Medium and Long-Term Science and Technology Development Plan for the Defense Industry," (Commission of Science, Technology and Industry for National Defense, 20 June 2007).

[58] "China Sets up Funds for Key Labs," *Xinhua News Agency*, March 3, 2008.

engineering and China's actions of reducing or cancelling orders after one or two batches of MWS were delivered. Thus, China's enhanced military industrial capacity and its aggressive pursuit of foreign military technology began to affect its availability of foreign suppliers, including its top supplier, Russia.[59] Under these conditions, military modernization was high (with a projected estimated value of about $23 billion for this period).

Period 7: 2010-2014

4.8 Developments in Military Modernization

Table 4.15: Chinese MWS, 2010-2014					
Designation	Category	Supplier	Year	Quantity	Projected Estimated Value
Z-10	Attack Helicopter	Indigenous	2010	90	$1,800
Type-99/99A	Tank	Indigenous	2010	550	$1,300
IL-76MD	Transport Aircraft	Russia	2010	10	$600
Shang-class Type-093	Submarine	Indigenous	2010	4	$2,000
Yuan-Class Type-039B	Submarine	Indigenous	2010	8	$2,400
Type-052C	Destroyer	Indigenous	2010	4	$2,500
J-10 / J-10C	Fighter Aircraft	Indigenous	2010	150	$4,200
J-11B	Fighter Aircraft	Indigenous	2010	100	$2,000
Type-054A	Frigate	Indigenous	2010	12	$3,600
Type-99/99A	Tank	Indigenous	2011	390	$1,000
Z-9	Helicopter	Indigenous	2011	125	$1,200
Type-056	Corvette	Indigenous	2011	22	$4,400
Type-094	Submarine	Indigenous	2011	2	$1,500
JL-8	Trainer Aircraft	Indigenous	2012	200	$2,000
Mi-17	Helicopter	Russia	2012	52	$850
Z-19	Attack Helicopter	Indigenous	2012	60	$1,000
Type-052D	Destroyer	Indigenous	2012	16	$7,600
IL-78M	Transport Aircraft	Ukraine	2011	3	$150
Shandong / Type-001A	Aircraft Carrier	Indigenous	2013	1	$4,000

[59] See for instance Paul N. Schwartz, "The Changing Nature and Implications of Russian Military Transfers to China," Center for Strategic and International Studies (CSIS) (Washington, D.C.: CSIS, June 21, 2021), pp. 1-8.

J-15	Fighter Aircraft	Indigenous	2013	60	$3,600
Total:					**$47,500**

China's military modernization in this period consisted of several major developments as shown in Table 4.15. During this period China's armed forces made advancements in: (1) naval surface combatants including aircraft carriers; (2) indigenous submarines; (3) transport aircraft; and (4) fighter aircraft.

During this period, the PLAN began production on dozens of principal surface combatants, many being corvettes, frigates, and destroyers. The Type-056 corvette is primarily a green-water vessel equipped for anti-ship and anti-submarine warfare. Because of reduced endurance, greater numbers are needed for continuous force projection, but its deployment along China's coast enables China's larger ships to engage in blue-water operations. China built 22 of these vessels in this period with some in the next period. The Type-054A frigate was developed to be the backbone frigate in the PLAN. Four vessels had been introduced in the previous time-period and was inducted in greater numbers in this period (12 vessels) and in the next period (14 vessels).[60] The advantage of large numbers of frigates gives the PLAN greater numbers with fewer crew members and relative mission flexibility, including anti-aircraft, anti-ship, and anti-submarine warfare. They are also less provocative than sending an aircraft carrier battle group or destroyer through sensitive areas, including Taiwan, Japan, and the Indian Ocean.

[60] For a cost estimate of the Type-054A, see Gabe Collins, "How Much Do China's Warships Actually Cost?" *The Diplomat*, June 15, 2015. The Type-054A was introduced gradually, starting in 2008 (4 vessels), and then 2010 (3), 2011 (2), 2012 (4), 2013 (3), 2015 (4), 2016 (3), 2017 (2), 2018 (3), and 2019 (2).

Also, the PLAN began production of its newest destroyer, the Type-052D.[61] Eventually, about 16 vessels of this class were launched between 2012-18 and commissioned between 2014-20.

Additionally, the PLAN began construction on the Type-001A (Shandong) aircraft carrier. It was China's first indigenously built aircraft carrier, roughly similar in tonnage (about 65,000 tons) and design to the Liaoning aircraft carrier, but with some improvements,[62] and capable of carrying 44 aircraft.[63] The ship was eventually launched in 2017, underwent nine sea trials starting from May 2018, and was commissioned into service in December 2019.

Second, in terms of submarines, the PLAN began production on additional Type-093 (Shang-class), Type-039A (Yuan-class), and the Type-094 (Jin-class).[64] The Type-093 is a nuclear-powered attack submarine designed to replace the Type-091. As noted earlier, two of these vessels were commissioned in the early 2000s, and an estimated three were in production in the mid-2000s, with an additional four in the early 2010s. With these commissions, China acquired a total of nine such submarines. The Type-039A represents China's first air-independent propulsion driven diesel-electric submarine and is considered one of China's quietest submarines. Likewise, the PLAN continued to expand its nuclear-powered ballistic

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[61] Toshi Yoshihara and James R. Holmes, "The Master PLAN: China's New Guided Missile Destroyer," *The Diplomat*, September 4, 2012.

[62] China Power Team, "What Do We Know (so far) about China's Second Aircraft Carrier?" China Power (Washington, D.C.: Center for Strategic and International Studies (CSIS) April 22, 2017), updated August 26, 2020.

[63] Peter W. Singer and Jeffrey Lin, "About Those Chinese Aircraft Carrier Pics: What We Know and What We Can Guess," *Defense One*, August 5, 2013.

[64] Ronald O'Rourke, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress,* May 2020 (Washington, D.C.: Congressional Research Service); and United States Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, April 2015 (Washington, D.C.: Department of the Navy).

missile fleet with additional Type-094s. By the end of this period, the PLAN expanded its submarine fleet to 70.

Third, China obtained transport and tanker aircraft. In 2010, it ordered 10 IL-76s (with deliveries starting in 2013, some procured from Belarus stocks). In 2011, it ordered 3 IL-78 tanker versions from Ukraine (delivered between 2014-2016). These orders were necessary because the 2005 contract with Russia for Il-76 and Il-78 planes had not resulted in deliveries by 2010. China also continued to obtain Mi-17/171 helicopters, so that by the late 2010s it had about 200 of these helicopters (including Mi-17/171, Mi-8MT/17, Mi-17V5, and other versions).

Finally, in terms of fighter aircraft, China began production of its J-15 naval fighter, a copy of the Russian Su-33 (itself a modified Su-27). Despite boasting impressive performance and maneuverability, the aircraft possesses major limitations as a naval fighter-bomber.[65] However, PLA officials argue that the J-15 is superior to the Su-33 because it possesses more powerful engines, improved avionics, and improved ground attack capabilities.[66] It is believed that the aircraft entered serial production in 2013 having completed flight testing and design modifications.[67]

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[65] Gabe Collins and Andrew Erickson, "China's J-15 No Game Changer," *The Diplomat*, June 23, 2011.

[66] *People's Daily Online*, "China's J-15 fighter superior to Russian Su-33," December 6, 2012.

[67] Zachary Keck, "China's Carrier-based J-15 Likely Enters Mass Production," *The Diplomat*, September 14, 2013.

4.8.2 Factors Contributing to Military Modernization

China's military modernization in 2010-2014 was influenced by military industrial capacity, foreign supply, military obsolescence, and changes in the security threat environment. These variables can be categorized as demand or supply oriented.

Demand Variables

Military obsolescence in 2010-2014 was moderate-high due to high rates of decommissioning throughout the PLA. First, the PLAN's principal surface combatants dropped from 80 to 72 during this period due to the decommissioning of 15 Luda-class (Type-051) destroyers. Second, the PLA decommissioned an estimated 1,000 Type-59 tanks but slowly began introducing the newer Type-98 and Type-99. Third, the PLAAF grew by over 20 percent to an estimated 2,200 aircraft, but included large numbers of older J-7 (Mig-21-type) aircraft.

The security threat environment was moderate despite pressure from ASEAN states over claims in the South China Sea and US accusations of cyber-espionage. Enhancing China's confidence in these diplomatic conflicts was the fact that the PLA had significantly closed the capabilities gap with the US, at least regionally. The PLA still lacked the ability to sustain global military power projection. Additionally, China surpassed Japan as the world's second-largest economy in 2010 and increased its proportion of power amongst the top states per the CINC in Table 4.16.[68]

Table 4.16: 2012 CINC Top 5

Country	Rank	CINC	T5-Prop
China	1	21.8%	42.4%
US	2	13.9%	27.1%
India	3	8.1%	15.7%

[68] David Barboza, "China Passes Japan as Second-Largest Economy," *The New York Times*, August 15, 2010.

Russia	4	4.0%	7.8%
Japan	5	3.6%	6.9%

Supply Variables

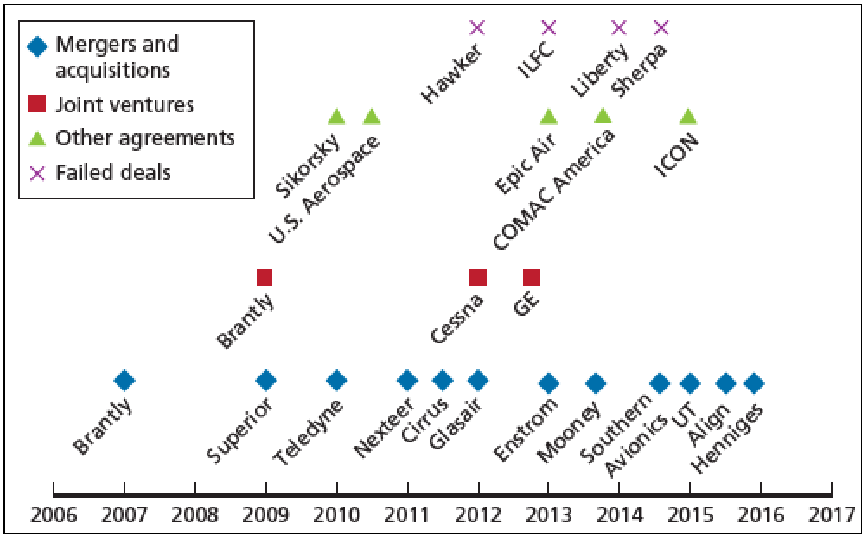
Military industrial capacity in 2010-2014 was high. During this period, GDP rose beyond $9 trillion while military expenditure grew from $143 billion to $200 billion. The steady growth of China's economy reinforced increases in R&D and high-technology exports (as % of manufactured exports), which eclipsed $8 billion and 31 percent, respectively. Human capital, however, plateaued at 20 percent, possibly signifying limitations in education policy or declining demographic trends. But in 2010, China's State Council and Central Committee elevated the Thousand Talents Plan to the state's highest national award for scientific research, particularly aimed at attracting and retaining foreign talent.[69]

Furthermore, China installed minor reforms to the military industrial complex, primarily breaking some state-run defense firms and promoting limited competition for defense contracts. One of the key areas of limited progress in China's military industrial capacity was China's aerospace industry which continued to underperform and meet PLAAF engine requirements. In 2010, the PLAAF had to purchase an additional 122 Russian AL-31 turbofan engines for its J-10 fleet as well as 55 D-30 turbofan engines for modernization of its transport aircraft.[70] As Figure 4.2 below demonstrates, China invested in the U.S. aviation sector in order to acquire U.S. aerospace technology transfer and expertise. China pursued this strategy consistently throughout the 2000s via various types of agreements and acquisitions in an effort to close the aerospace capacity and technology gap.

[69] Ryan Fedasiuk and Jacob Feldgoise, *The Youth Thousand Talents Plan and China's Military*, CSET Issue Brief (Washington, D.C.: Center for Security and Emerging Technology, August 2020).

[70] SIPRI Arms Transfer Database, April 2017.

Figure 4.2: Timeline of Chinese Investments in U.S. Aviation[71]



Foreign supply of China's MWS remained low this period. China solidified its back-door strategy of technology acquisition despite the West's arms embargo, enforced by the US and Great Britain. The embargo did, however, weaken in terms of technology transfer, which China exploited. "In one famous case, after 75 percent of the British company Dynex Semiconductor was acquired by a Chinese civilian locomotive company, an advanced technology developed by Dynex ended up in the aircraft launch systems on China's first domestically built aircraft carrier."[72]

China's efforts at industrial espionage and wide-scale reverse-engineering deterred major state suppliers from selling MWS to China. Even Russia began to avoid exporting its best MWS such as the Su-35. These fears stymied or at the very least complicated further arms negotiations. China repeatedly sought to persuade Europe to repeal the European arms embargo without success. On multiple occasions China managed to bypass the arms transfer limitation through

[71] Chad J. R. Ohlandt, Lyle J. Morris, Julia A. Thompson, Arthur Chan, Andrew Scobell; "Chinese Investment in U.S. Aviation," RAND Corporation, 2017, p. xii.

[72] Anja Manuel and Kathleen Hicks, "Can China's Military Win the Tech War?" *Foreign Affairs*, July 29 2020.

various legal loopholes and by exploiting inadequate or ambiguous material export control lists. China was creative and aggressive in its pursuit of foreign technology.[73] In the case of stealth technology, Chinese agents scoured the Serbian countryside buying pieces of an F-117 shot down by Serbian fighters.[74] Furthermore, PLA-affiliated cyber groups have been identified as the perpetrators behind online military technology theft.[75] In early 2013, a Pentagon report revealed that several advanced US weapons systems had been compromised, including the designs of systems related to the F-35 Joint Strike Fighter.[76] Finally, PLA engineers acquired or examined Western arms through friendly third parties such as Pakistan, which was the recipient of American F-16 fighter jets, missiles, and other weapon systems. As a result of many of these alternative methods, China succeeded in mitigating certain technology gaps.

To summarize, the combination of moderate-high military obsolescence and moderate security threat environment contributed to moderate-high demand for military modernization. At the same time, high military industrial capacity and low foreign supply resulted in moderate arms supply. Due to China's enhanced military industrial capacity, its military obsolescence decreased for the first time in this study. Together with a moderate security threat environment China's assessed demand for military modernization was still moderate-high. China's available foreign suppliers for state-of-the-art MWS dropped as Russia had concerns about supply in large part due to China's production of the J-11B fighter aircraft, J-15 fighter aircraft, and the Y-9

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[73] Simon Cooper, "How China Steals U.S. Military Secrets," *Popular Mechanics*, July 10, 2009.

[74] "China Stealth Fighter Copied Parts from Downed US Jet," *BBC News*, January 24, 2011.

[75] John Reed, "Red Star: Another Advanced Hacking Crew from China is Revealed," *Foreign Policy*, June 4, 2013. See also David E. Sanger, "U.S. Blames China's Military Directly for Cyberattacks," *The New York Times*, May 6, 2013.

[76] Ellen Nakashima, "Confidential report lists U.S. weapons system designs compromised by Chinese cyberspies," *The Washington Post*, May 27, 2013.

transport—all copied from the Russian Su-27, Su-33, and the An-12, respectively. This situation demonstrates an unusual dynamic between military industrial capacity and available foreign supply. China needed to import several foreign MWS to not only mitigate military obsolescence but also to infuse technology into its military industrial capacity. Yet, this infusion and later production of indigenous copies of foreign MWS undermines future availability of foreign supply. Under these conditions, military modernization was very high (with a projected estimated value of about $48 billion for this period).

Period 8: 2015-2018

4.9 Developments in Military Modernization

Table 4.17: Chinese MWS, 2015-2018

Designation	Category	Supplier	Year	Quantity	Projected Estimated Value
Type-99A	Tank	Indigenous	2015	250	$625
Type-054	Frigate	Indigenous	2015	2	$700
Type-054A	Frigate	Indigenous	2015	14	$4,200
Type-056A	Corvette	Indigenous	2015	50	$10,000
Z-10	Attack Helicopter	Indigenous	2015	60	$1,020
Z-19	Attack Helicopter	Indigenous	2015	60	$1,140
Z-8B	Transport Helicopter	Indigenous	2015	50	$850
Su-35	Fighter Aircraft	Russia	2016	24	$2,000
J-20	Fighter Aircraft	Indigenous	2017	60	$4,500
Type-055	Destroyer	Indigenous	2017	8	$3,600
Type-002	Aircraft Carrier	Indigenous	2018	1	$5,000
Y-20	Transport Aircraft	Indigenous	2018	5	$1,000
Total:					**34,500**

China's military modernization in this period consisted of some key developments as shown in Table 4.17. During this period China's armed forces made advancements in naval vessels, including frigates, destroyers, and a new aircraft carrier, fighter and stealth aircraft, and transport aircraft.

In November 2015, China negotiated to purchase 24 Su-35 multi-role fighters, a deal worth $2 billion.[77] The aircraft features two Saturn AL-117S engines, a sizeable upgrade to the AL-31FN already incorporated in the J-10. The Su-35 is a major boost in PLA air capabilities. The deal is further surprising since China has a history of reverse-engineering Russian MWS and copyright infringement, particularly the Su-27/J-11 ordeal.

In terms of stealth aircraft, Western observers were aware of a Chinese stealth program after 2000; however, the maiden test flight of the J-20 in January 2011 caught most China observers off-guard. In October 2012, the smaller J-31 prototype made its first flight test. Together, the two aircraft signal the depth and maturity of China's stealth program as well as its emerging strategic interests. Despite their recent demonstrations, both aircraft raise many unanswered questions. For instance, Chinese engineers have struggled to develop radar-absorbent composite materials, integrate sophisticated avionics capabilities, and develop and equip Active Electronically Scanned Array radars. China's defense industry has thus far been unable to demonstrate that it has mastered these technologies and others like aerospace thrust vectoring engines.[78] Thus far, three J-20 prototypes have been built with each undergoing regular flight testing. The biggest uncertainty is what engine type the J-20 will ultimately feature. The PLAAF is reportedly experimenting with both the Russian AL-31 and the Chinese WS-10.[79] Most experts agree that even using an optimistic outlook, the J-20 will not become operational until the mid-2020s or thereafter. While the US uses an extensive program for testing new aircraft including thousands of hours of test flights, the PLAAF uses a more incremental

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[77] Zachary Keck, "China's Last Order of Russia's Su-35 Fighter Is Coming This Year," *The National Interest*, June 3, 2018.

[78] Cheung, "The Chinese Defense Economy's Long March," pp. 332.

[79] "Chinese 'Mighty Dragon' doomed to breathe Russian fire," *RT News*, March 11, 2012.

approach. It is likely that China will forego exhaustive testing and instead produce an initial batch of several aircraft and deliver them to a squadron where they can engage in 'operational' testing before final designs are approved for mass production.

China also began building the indigenous heavy lift aircraft, the Y-20, which had started prototype flight testing in 2013. This was similar to the US C-17 heavy-lift transport aircraft though smaller in size and payload capacity, reportedly capable of carrying 140 troops and flying 2,700 miles. However, it is believed that the Y-20's development was significantly aided by a major cyber espionage campaign against Boeing, which builds the C-17.[80] The PLA deployed a few Y-20s by 2018 and had perhaps 20 by 2020.[81]

Finally, in terms of naval systems, China continued to augment its fleet of destroyers, frigates, and corvettes. It obtained more Type 054 frigates. It started production of its latest destroyer, the Type 055, with eight such vessels launched between 2017 and 2020 and the first commissioned in 2020. It also commissioned dozens of Type 056A corvettes (intending to procure 50 such vessels) that supplemented the Type 056 developed in the early 2010s. Further, the Chinese press stated in November 2018 that China had begun construction of the Type 002 aircraft carrier, with a displacement of 80,000 tons to 85,000 tons.[82]

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[80] Kelsey D. Atherton, "Chinese Hacker Pleads Guilty To Stealing Jet Plans," *Popular Science*, March 24, 2016.

[81] US-China Economic and Security Review Commission, *2020 Report to Congress*, Fiscal Year 2021 (Washington, D.C.: US Government Publishing Office, December 2020), p.399. The *Military Balance 2021* (IISS, 2021) notes that China had 20 Il-76 and 2 Y-20 in 2016, and that the Y-20 fleet increased to 7 by 2018 and 22 by 2020, so that China had more Y-20 than Il-76 by 2020.

[82] Ronald O'Rourke, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress*, RL33153 (Washington, DC: Congressional Research Service, 17 December 2020).

4.7.2 Factors Contributing to Military Modernization

China's military modernization in 2015-2018 was influenced by military industrial capacity, foreign supply, military obsolescence, and changes in the security threat environment. These variables can be categorized as demand or supply oriented.

Demand Variables

Military obsolescence decreased to moderate as less than 50 percent of the PLA force structure was beyond 30 years operability. For the first time in nearly 40 years, the PLA possessed a force with the majority of the equipment not aging, and some with state-of-the-art capabilities. Notably, the PLAN grew from 70 to 83 principal surface combatant ships during this period. The PLAAF grew from 2,200 to 2,400 combat capable aircraft. The vast majority of these force structure advancements came from indigenous production, thus replacing legacy Soviet systems. In terms of technological obsolescence and the state-of-the-art of these MWS, several studies indicate that many of the PLA's conventional capabilities are comparable to Western powers.[83]

The security threat environment was moderate-high due to rising tensions in the South China Sea and along the Indian border. China's growth prompted US strategic reposturing towards the Indo-Pacific region, which included the realignment of forces in the region as well as further arms transfers to Taiwan. China maintained its hardline approach to its territorial claims in the South China Sea, prompting continued rebukes from its neighbors in Southeast Asia. To deter and mitigate China's claims, Western states including the US, Britain, and France maintained freedom of navigation operations (FONOPs). In the summer of 2017, China began

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[83] U.S. Defense Intelligence Agency, *China Military Power: Modernizing a Force to Fight and Win*, January 2019 (Washington, D.C.: Department of Defense), p.52.

constructing a road across the Doklam Plateau in Bhutan, prompting a strong response from India which threatened to destroy the road. The situation was raised at the highest political levels and underscored the sensitivity of the Sino-Indian border disputes. Furthermore, while CINC and T5-Prop data is not available for this period, China continued to outpace all rivals in the growth of its national capabilities, particularly economically.

Supply Variables

Military industrial capacity was high due to further progress in economic and scientific inputs. China's GDP grew to $10 trillion enabling increased military expenditure and other investment into military industrial capacity. Military expenditure grew from $214 billion in 2015 to $253 billion by 2018.[84] Military R&D rose to an estimated $20 billion annually. High-technology exports (as % of manufactured exports) rose to 31 percent demonstrating maturity in China's technology industry. Human capital measured by gross tertiary education enrollment jumped from 36 percent in 2014 to 46 percent in 2015, eventually reaching 51 percent by the end of the period. This significant increase demonstrated major improvements in China's education system and state goals. Additionally, in 2017 China established its own version of the DARPA, known in China as the "Military Steering Committee on Innovation."[85] While the Committee would have minimal impact on military modernization during this period, its creation further underscored the significance of military innovation with the CCP and PLA.

In terms of policy reforms, China initiated major reforms in 2015 with the introduction of its 10th defense white paper. While the strategy outlined many structural reforms (including the

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[84] Based on SIPRI 2018 constant USD.

[85] Vasilis Trigkas, "China Has Its DARPA, But Does it Have the Right People?" *The Diplomat*, August 9, 2017.

reduction of 300,000 personnel) in the PLA, two of its biggest themes were emphasis on civil-military integration and force management and human capital development.[86] To accomplish these goals, the strategy advocates for greater coordination between the civilian and military sectors to eliminate inefficiencies and enhance collaboration on critical technologies. Likewise, the CCP and PLA have realized the strategic importance of human capital within the military and civilian sector. The strategy advocates for greater professionalization and investment in critical information and technological areas. Part of this strategy included establishing "science cities" and industrial/tech parks near China's primary industrial corporations and manufacturing centers.[87]

Foreign supply remained low as Russia offered fewer MWS and the West reinvigorated its arms embargo over increasing PLA capabilities and claims of intellectual property theft. This reconsideration of the arms embargo and the "China threat" in general was highlighted in various debates across Europe over whether or not to permit Chinese 5G cellular technology infrastructure over fears of Chinese "backdoors" in the components traversing European mobile and digital networks. Likewise, dual-use licensing deals and foreign arms company acquisitions declined on the heels of these concerns. In particular, China had been negotiating to purchase some dual-use technology companies in Eastern Europe. Ultimately, China's vulnerability in leveraging foreign arms suppliers was likely impacted by changes in the international strategic threat posed by China against the world's top arms suppliers as well as its aggressive program of licit and illicit technology acquisition that consistently appeared in Chinese MWS, which in-turn has increasingly undercut some Western international arms transfers. Over time, China's lack of

[86] U.S.-China Economic and Security Review Commission, *Highlights from China's New Defense White Paper, "China's Military Strategy,"* June 1, 2015 (Washington, D.C.: U.S. Congress), p. 3.

[87] U.S. Defense Intelligence Agency, *China Military Power*, p. 49 and pp. 105-106.

cooperative and available foreign arms suppliers has almost certainly driven an aggressive approach to expand military industrial capacity by any means necessary.

To summarize, the combination of moderate military obsolescence and moderate-high security threat environment contributed to moderate demand for military modernization. At the same time, high military industrial capacity and low foreign supply resulted in moderate arms supply. Under these conditions, military modernization was high (with a projected estimated value of about $34.5 billion for this period). However, if this period had included data from 2019, it would have measured very high. Most of China's observed military modernization trends continued on their current pace or expanded beyond 2018.

Once again, China's security threat environment shifted in a meaningful way. As India pivoted its national defense strategy more towards China and as the US and various Southeast Asian states began resisting China's claims in the South China Sea, regional instability increased. China's growth in national capabilities, reinforced by the unsettled island disputes and flashpoints, altered by the security threat environment for other states in the region. What is unclear is whether China will use these security considerations to justify further military modernization or reduce it since military obsolescence has declined. Surprisingly, Russia agreed to sell the Su-35 fighter aircraft to China despite concerns over reverse-engineering. Likewise, China's competitiveness in international arms exports demonstrates, by one measure, the improving quality of Chinese MWS. According to SIPRI, "Chinese exports of major arms increased by 88 percent between 2006–10 and 2011–15, and China's share of global arms exports rose from 3.6 to 5.9 percent."[88] Additionally, the number of states China exported arms

[88] Sam Perlo-Freeman, Pieter D. Wezeman, Siemon T. Wezeman, and Dr Aude Fleurant, *Trends in International Arms Transfers, 2015*, SIPRI Fact Sheet February 2016 (Solna: SIPRI, 2016), p. 3.

to grew from 37 to 51 between 2015 and 2020, with Pakistan being China's top export market.[89] Thus, China's growing national capabilities and military modernization, underscored by high levels of military industrial capacity and its growing status as a major arms supplier, has had significant influence on Chinese military modernization as well as significant implications for regional and international security.

4.9 CONCLUSION

As a result of its military modernization since the 1980s, China had a relatively advanced military force by the late 2010s and early 2020s, both in quality and quantity. For example, comparing China's naval forces in 2005 with 2018, China's number of diesel attack submarines was the same at nearly 50, but these were more modern designs including nuclear-powered attack submarines. China's aircraft carrier fleet grew from zero to two operational carriers with a third near completion. It increased its number of destroyers by 12, frigates by 11, and corvettes by 42. Overall, by 2020, the PLAN had two aircraft carriers, six nuclear-powered attack submarines, 47 diesel attack submarines, 40 destroyers, and 100 frigates and corvettes.[90]

PLA Air Force modernization also emphasized building strategic depth with long-range strike and territorial air defense systems, and the weapons systems introduced in the early 2010s can reach and go beyond Taiwan to interdict US military aircraft and naval vessels in these

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[89] Ibid, p. 3; SIPRI Fact Sheet March 2021, p. 5.

[90] Ronald O'Rourke, "China Naval Modernization," 2020. Most of the naval fleet comprised Type 055 destroyers (13,000 tons); Type 051 and 052 destroyers (6,000-7,000 tons); Type 054A frigates (4,000 tons); Type 053 frigates (2,400 tons); Type 056 /056A corvettes (1,500 tons); Type 093 nuclear-powered attack submarines (7,000 tons); and Type 039 (2,000 tons) and 039A/B (3,600 tons) conventional submarines.

areas.[91] China fielded advanced fighter jets, including the fourth-generation Su-35 procured from Russia and the J-16 and J-10C as well as the Chinese-built fifth-generation J-20. Overall, China obtained over 600 Su-27 and their variants since the first order in 1991—these included the Russian built Su-27SK since 1992, Su-30MKK since late 2000, Su-30Mk2 (navy) since 2004, Su-35 since 2016, the Russian-based but Chinese assembled J-11 since 1999 and J-11A since 2001, and the Chinese built J-11B (navy) since 2010, J-15 (navy) since 2015, and J-16 since 2016.[92]

As for ground forces, by 2020, China's tank inventory stood at 5,600 main battle tanks. These comprised about 1,400 first-generation tanks, mostly Type-59 and derivatives including Type-79; about 1,300 second-generation tanks, including some Type-88A/B and many Type-96; about 1,500 second-to-third-generation Type-96A; and 1,200 third-generation Type-99 and Type-99A.[93]

This chapter shows the interaction of military industrial capacity, access to foreign resources, military obsolescence, and the security threat environment influenced military modernization in China in several different ways and in varying degrees of significance over time.

In regards to military industrial capacity, an inability to pursue, absorb, and adapt foreign technology limited China's domestic arms industries. In the early 1980s, party leaders made a profound decision to forego large-scale military modernization. Due to an inability to develop

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[91] U.S.-China Economic and Security Review Commission, 2020, pp. 386-418.

[92] As per the IISS *Military Balance* 2021, China then had 95 J-11 and 32 Su-27UBK fighters, as well as over 800 fighter ground attack planes (including 220 J-10A; 55 J-10B; 120+ J-10C; 70 J-10S; 130 J-11B/BS; 150 J-16; 24 J-20A; 73 Su-30MKK; and 24 Su-35).

[93] IISS, *The Military Balance 2021*.

and produce modern MWS at home, defense planners had to produce older Soviet legacy MWS. This trend continued into the 1990s, requiring the PLA to import significant amounts of arms and equipment. At some point in the late-1990s or early 2000s, China shifted to a more aggressive approach to foreign technology acquisition, including acquisition facilitated by cyber espionage.[94] This approach was further aided by state policies that encouraged and even coerced the transfer of foreign intellectual property in exchange for better access (with some limitations) to the Chinese market. This complex and aggressive approach supplanted traditional forms of R&D and likely enabled advancement in key sectors of the Chinese economy, which directly and indirectly facilitated better military industrial capacity. Ultimately, this approach had negative implications for subsequent foreign arms supply from Russia and growing international condemnation in response to intellectual property theft. After the security environment, changes in this factor almost certainly had the biggest impact on military modernization.

In regards to foreign supply, China faced significant limitations throughout the entire period of observation. Soviet arms were off-limits during the 1980s until 1990 after the collapse of the Soviet Union. The Western arms embargo implemented in 1989, however, had more severe long-term effects. Due to these constraints, China's arms industry was kept away from major advancements in Western military technology, forcing them and the PLA to pursue alternative methods of acquisition, as noted earlier. This lack of supply likely reinforced the strategic imperative of building strong military industrial capacity that was not dependent on foreign states. Nonetheless, expanded access to Russian arms in the 1990s and civilian economic partnerships in the 2000s allowed China to close many technological and resource gaps.

[94] See for instance Mark A. Stokes, Jenny Lin, and L.C. Russell Hsiao, "The Chinese People's Liberation Army Signals Intelligence and Cyber Reconnaissance Infrastructure," Project 2049 Institute, November 11, 2011, pp. 1-32.

In regards to military obsolescence, the PLA force structure faced constant technological and block obsolescence of its MWS until the turn of the century. As a result, the PLA pursued stop-gap acquisitions from Russia to fulfill immediate security needs. Furthermore, as the domestic arms industry modernized and acquired foreign technology, it has been called upon to overhaul the entire force structure. As a result, the impact of this variable was strongest after 2000.

In regards to the security threat environment, the dynamics of power and security changed significantly in East Asia after 1995. Increased tensions across the Taiwan Strait, competition over resources in the South China Sea, and advances in US capabilities, as demonstrated in RMA, likely influenced China's military modernization priorities.

In sum, China's military modernization was significantly driven by changes in the security threat environment and inadequate available foreign supply, which in-turn triggered intense changes and investment in military industrial capacity to meet security goals. These advancements are attributable to both deliberate calculation and coincidence. The double-digit increases in defense spending beginning in the late 1990s were a dividend resulting from decisions by Deng Xiaoping and China's leaders in the early 1980s and the then prevailing perception of a stable security threat environment. Unlike India, China almost certainly instituted a state-driven campaign to absorb and assimilate as much foreign technology, both civilian and military, as possible through licit and illicit means to fundamentally alter its national capabilities and counterintuitively reduce reliance and strategic vulnerability. Despite limited foreign arms suppliers, China maximized what suppliers it had by importing large amounts of Russian arms and then systematically reverse-engineering them to absorb Russian technology and refine their MWS production processes. Subsequent increases in defense spending contributed to China's military modernization, at the same time as the recognition of RMA following the Gulf War and the turnaround of China's economy in 1990.[95] Compared to India, China benefitted from more effective state-driven defense reforms and technology acquisition. Yet, its rapid development and increased defense capabilities redefined the security threat environment in the region as most states began various forms of diplomatic resistance and counterbalancing. While China's approach to military modernization may have yielded large returns in the 2010s, the long-term costs of greater competition from the region and foreign resistance may create many unexpected challenges and potential for conflict.

[95] This is not to say that the embargoes enacted by the West following the Tiananmen Square massacre were not detrimental. China benefited from the collapse of the Soviet Union and its willingness to sell advanced surplus arms to China.

Chapter V

Comparative Assessment and Conclusion

5.1 Introduction

The previous chapters examined how military modernization in China and India varied with changes in military industrial capacity, foreign supply, military obsolescence, and the security threat environment during eight time periods. Furthermore, they documented and highlighted some of the contrasting patterns of stagnation and progress in military modernization. These observations have implications for two assumptions in international relations and policy discourse: that military power is commensurate with economic power and that states intend to or are capable of maximizing military power. This chapter provides a comparative assessment of the two cases and patterns across the variables. It concludes with a brief statement on the state of military competition between the two rising powers.

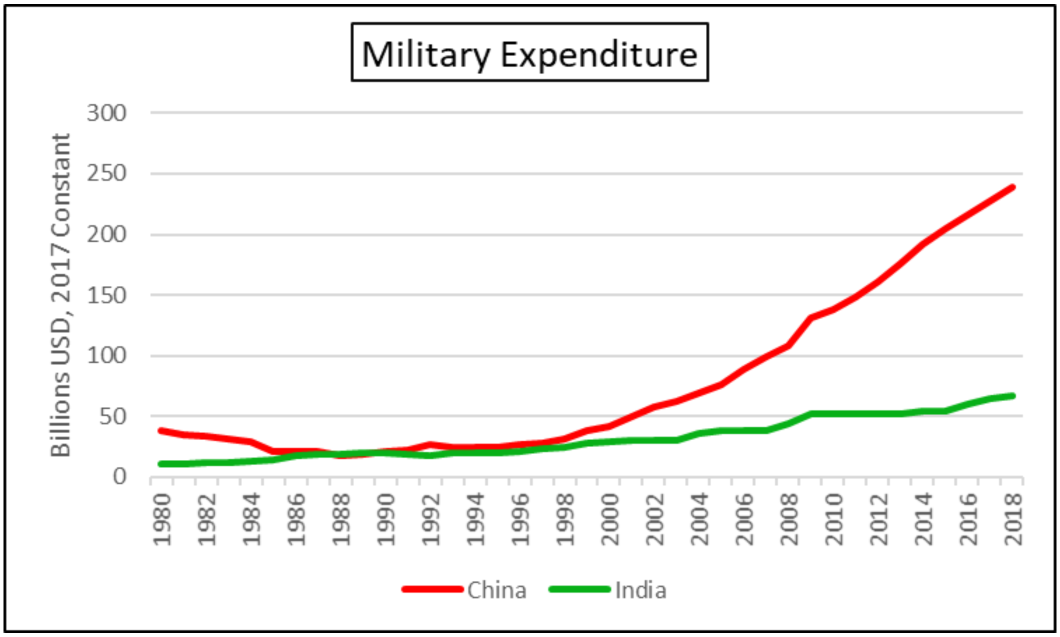
5.2 Military Modernization: Patterns and Variation across the Cases

This study identifies three key observations related to expenditure, temporal similarities and differences, and force structure regarding military modernization.

Overall Expenditures

China's military modernization from 1980 to 2018 was at least 50% higher than India's. While dollar values vary across sources using different methodologies, a rough estimate, based on standardized 2010 dollars, is that China's modernization in major conventional systems totaled around $160-170 billion and India's totaled $110-120 billion. Similarly, China's defense budget continues to outpace India's. In 2018, China's military expenditure (which is related to defense budgets, as calculated by SIPRI), was an estimated $239 billion compared to $66 billion in India.[1] Between 2000 and 2012, China's military expenditure nearly quadrupled from $41 billion to $161 billion, according to SIPRI. Figure 5.1 demonstrates this growing gap in expenditure over time.

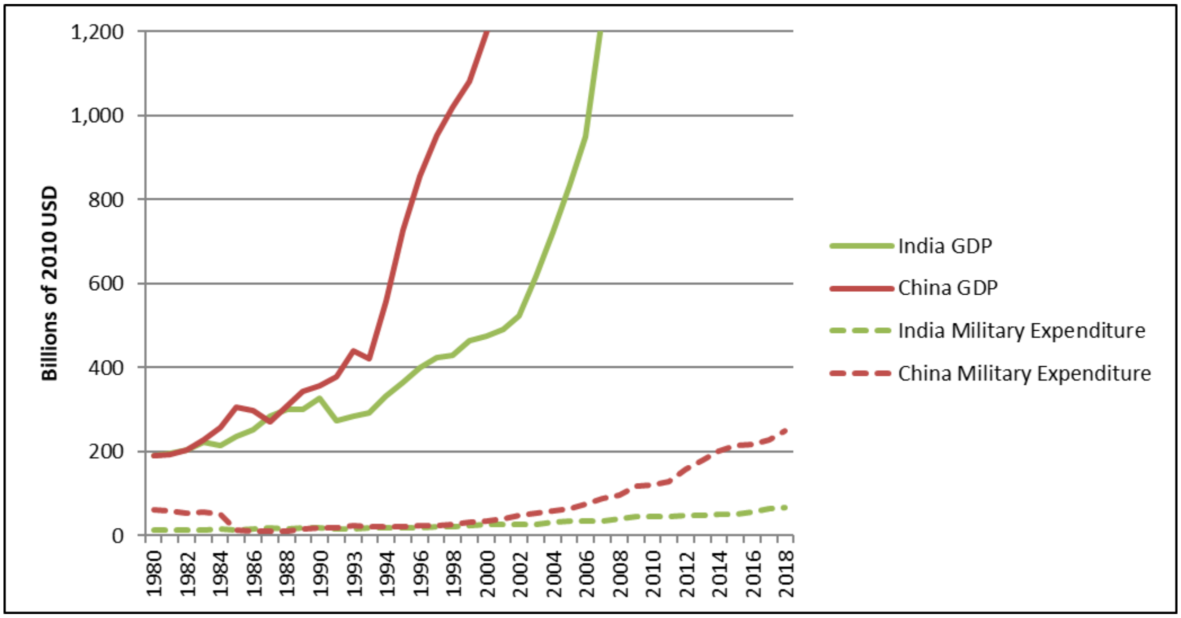
Figure 5.1: Comparison of Military Expenditure and GDP



This increase is paralleled by huge growth in the Chinese economy which has grown from $1.3 trillion in 2000 to nearly $11 trillion in 2018, thus fueling rapid defense expenditure. Conversely, India's defense expenditure averaged 10 percent growth in the 2010s but has been often constrained by fluctuations in the value of the Indian rupee and periods of economic stagnation.

[1] Estimates taken from the SIPRI Military Expenditure Database, November 2020.

Figure 5.2: Comparison of GDP and Military Expenditure



Modernization Across Time

The rate of military modernization in China and India has varied across time. As Table 5.1 demonstrates, military modernization was high in India in the early 2000s and then in the late 2000s and 2010s (Periods 1 and 6-8 in this dissertation). In China, military modernization was high in the 2000s and very high in the 2010s (Periods 5-8 in this dissertation).

Table 5.1: Military Modernization Based on Projected Estimated Value

	P1 (1980-1984)	P2 (1985-1989)	P3 (1990-1994)	P4 (1995-1999)	P5 (2000-2004)	P6 (2005-2009)	P7 (2010 - 2014)	P8 (2015 - 2018)
China	LOW	LOW	MODERATE	MODERATE	HIGH	HIGH	VERY HIGH	HIGH
India	MODERATE / NEAR HIGH	LOW	LOW	LOW	MODERATE / NEAR HIGH	HIGH	HIGH	HIGH

Changes in Force Structure

Both China and India have significantly altered the size and nature of their respective force structures. These changes can be described in respect to the three military services. First, investment in naval forces has seen a dramatic increase in both cases. China's major weapons system (MWS) procurement has outpaced India's, especially in terms of naval modernization. China has spent double (approximately $50 billion as per the methodology in this study) on major naval modernization compared to India (approximately $25 billion). China's spike in naval modernization began in the early 2000s and continued to increase in Period 6. In China, these investments have gone towards upgrading a large submarine fleet as well as building the world's second largest fleet of principal surface combatant ships, according to *The Military Balance*. Between 1980 and 2018, the People's Liberation Army Navy (PLAN) grew from near 40 principal surface combatants to over 80.[2] The Indian navy, on the other hand, shrunk from about 40 principal surface combatant ships to near 30 in the same period. In 2020, the Chinese navy was three to four times larger than India's. China then had 2 aircraft carriers, 6 nuclear-powered attack submarines, 47 diesel attack submarines, 40 destroyers, and 45 frigates. Its naval aviation arm had 40 bombers (H-6 versions), 120 attack aircraft (JH-7/7A), 150 fighter / attack aircraft (Su-30 and equivalent J-11/ J-15*)*, and 16 anti-submarine or maritime patrol aircraft (Y-8 / KQ-200). India had 1 aircraft carrier with a second near completion, 1 nuclear-powered attack submarine, 15 diesel attack submarines, 10 destroyers, and 16 frigates. Its naval aviation wing had 40 fighter aircraft (MiG-29) and 13 maritime patrol or anti-submarine aircraft (including 8 US-supplied P-8s).

[2] Conversely, the PLAN's submarine fleet has shrunk from 97 submarines in 1980 to 62 in 2018. This is primarily a result of decommissioning over 50 1950s-era Romeo class attack submarines.

Second, investment in aerial capabilities has risen sharply as well. In the periods under study, China acquired far more combat aircraft than India. Despite the high priority both states placed in fighter aircraft modernization, a couple of clarifications are in order. China's air force modernization is skewed towards the latter periods, the 2000s and 2010s, whereas India's is balanced by higher air force modernization in Period 1 (1980-1984). Moreover, China's quantitative advantage in fighter aircraft is a result of continued deployment of low-cost 1960s/1970s-era Soviet aircraft, though China's more modernized aircraft that came into service in the 2000s and 2010s also outnumber India's modern fleet. In 2020, China's air force had approximately 1,500 combat aircraft while the Indian air force had 700.[3] Air force modernization has also become more costly in the last two decades because of increasing per-unit costs of modern aircraft. Both nations displayed a renewed focus on transport aircraft and aerial refueling tankers in the late 2000s and 2010s; these platforms are considered critical for expanding power projection capabilities. The Chinese air force transport fleet in 2020 included 40 heavy-lift planes (a mix of Il-76 and Y-20) and 50 medium-lift aircraft (Y-8 and Y-9), as well as light transport aircraft. The IAF transport fleet included 28 heavy-lift (C-17 Globemaster and Il-76); 10 medium-capacity (C-130 Hercules); and 100 light transports (An-32).

Third, ground force modernization experienced less priority in respect to the other services in both China and India; however, as a whole, ground forces remain the dominant force both in terms of expenditure and personnel in either case. Ground mechanization (tanks and armored personnel carriers) has taken a back seat to mobility via increased numbers of

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[3] In 2020, China's air force had a) 500 fighters (though 400 were obsolete J-7 (Mig-21) and J-8 while 100 were modern Su-27/35 or equivalent J-11 types); b) 800 fighter ground attack aircraft (approximately 400 J-10 variants and 400 Su-27/35/30 variants); and c) 100 JH-7A attack aircraft and 100 H-6 bombers. India's air force had a) 60 fighters (Mig-29), b) 500 fighter ground attack planes (including 260 Su-30, 50 Mirage 2000, and 150 obsolete MiG-21s), and c) 100 attack aircraft (Jaguars). Source: *The Military Balance 2021*.

helicopters and transport aircraft. In India, army modernization was highest in the 2000s (especially Period 5). This was a result of new tank orders (1,000 T-90 and about 100 Arjun) and Mi-17 helicopters from Russia. In China, army modernization was high in and since the late 2000s, influenced in part by increased helicopter orders including the Mi-17 from Russia and the indigenous Z-10 and Z-19 attack helicopter, as well as increased numbers of third-generation Type-99/99A tanks.

Overall, in terms of main battle tanks, China (5,600) had many more than India (3,600) as per 2020 data. But the numbers were comparable in second or second-to-third generation versions (China had 2,700 Type-88, Type-96, and Type-96A, while India had 2,400 T-72) and in third-generation designs (China had 1,200 Type-99/99A while India had 1,100 T-90).

In terms of helicopter fleets, India's was mostly operated by its air force while China's was mostly with its army. In 2020, China's army had over 200 attack helicopters (the Z-10 and Z-19), and over 300 multi-role helicopters (80 Mi-17 and 200 Z-9), as well as 300 transport helicopters (100 heavy-lift Z-8 and 200 medium-lift that were mostly Mi-17 and Mi-8). Its air force included 18 heavy lift (Z-8) and 13 medium-lift helicopters. The IAF helicopter fleet included 40 attack helicopters (equal numbers of older Mi-24/25 and newer Apache); about 300 multirole helicopters (that included 200 Mi-17 mostly for transport and 60 Dhruv light helicopters); and 15 heavy-lift transport helicopters (CH-47 Chinook). The Indian army had 80 Dhruv and 50 Dhruv attack versions (Rudra).

Unconventional Arms and Emerging Capabilities

In addition to the conventional MWS discussed above, China and India are pursuing the acquisition of other unconventional and strategic-oriented arms. These weapons and capabilities include advanced missiles, cyber-warfare capabilities, space-based capabilities, and unmanned aerial vehicles (UAVs). Though they were not discussed in this dissertation, largely because these capabilities were absent in the 1980s-1990s-2000s and only became prominent in the 2010s, it is important to understand where MWS development lies in the future.

China is currently believed to possess one of the largest ballistic missile programs in the world. China's short-range missiles are largely conventional: the long-range missiles are for nuclear delivery and the medium-range and intermediate-range missiles were developed for nuclear delivery but have also taken on conventional roles. The PLA operates over 20 ballistic missile variants with an estimated 400 launchers, the majority of which are road-mobile.[4] The Pentagon expects the PLA's ballistic missile program to continue to grow both qualitatively and quantitatively.[5] As part of this growth, China has deployed conventional versions of medium-range and intermediate-range missiles, such as the DF-21 anti-ship ballistic missile, and also new nuclear missiles such as the upgraded JL-2 submarine-launched ballistic missile (SLBM), and the JL-3 SLBM.[6]

In terms of cyber warfare capabilities, China has been documented as the primary perpetrator behind cyber-attacks against the US.[7] While much is unknown about the size and

[4] National Air and Space Intelligence Center, "Ballistic and Cruise Missile Threat" (Dayton, OH: NASIC, 2020), pp. 1-40.

[5] Office the Secretary of Defense, "Annual Report to Congress: Military and Security Developments Involving the People's Republic of China, 2020," (Washington, DC: Office of the Secretary of Defense, 2020), pp. 2-5.

[6] NASIC, Ballistic and Cruise Missile Threat, p. 30.

[7] U.S. Defense Intelligence Agency, *China Military Power: Modernizing a Force to Fight and Win*, January 2019 (Washington, D.C.: Department of Defense), pp. 1-140.

structure of the PLA's cyber warfare capabilities, known attacks against US commercial entities have been linked to PLA units.[8]

In terms of space capabilities, China has grown its space program by expanding its operations and increasing its launches of satellites. It has also demonstrated that it can undertake manned missions.[9] Additionally, China has demonstrated the military potential of its space capabilities twice. In 2007, it targeted one of its own defunct satellites in an aggressive anti-satellite (ASAT) test. In October 2013, China demonstrated the ability to capture another satellite without blowing it up. Furthermore, in 2012 China surpassed the US record of 18 space launches with 19 space launches of its own. By the late 2010s, China was conducting 20-30 launches each year.

In terms of UAVs, China could match or supplant Israel and the US as the top exporter of UAVs.[10] The PLA has expanded the number of UAV models that it operates from six to several tens, demonstrating the growth and importance placed on the program. Likewise, China is building additional bases for staging and deploying its UAVs. The PLA is also transforming some of its outdated J-6 fighters into UAVs, much like the US is with its F-16s.[11]

Similarly, India has been expanding its strategic and unconventional weapons capabilities. In terms of ballistic missiles, India's missiles are largely intended for nuclear delivery. It has already developed and deployed the short-range Prithvi I (range 150 km), the

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[8] Mandiant, "Exposing One of China's Espionage Units," June 2013.

[9] Mark Stokes, Gabriel Alvarado, Emily Weinstein, and Ian Easton, The U.S.-China Economic and Security Review Commission, *China's Space and Counterspace Capabilities and Activities*, March 30, 2020, pp. 1-116.

[10] China Power Team. "Is China at the Forefront of Drone Technology?" China Power, May 29, 2018. Updated August 25, 2020.

[11] "Unmanned J-6 Fighter Jets Put on Fujian Air Base," *Focus Taiwan*, January 7, 2013.

Agni I and II (range 700 & 2,000 km, respectively), the Agni-III (3,000 km), and Agni-IV (4,000 km).[12] The Agni V has been tested several times in the 2010s, and when it is deployed, it will be India's most potent nuclear capable missile with a range of 5,500 km. Likewise, the missile is reportedly being equipped with multiple independent re-entry vehicles (MIRV). The DRDO is also developing two types of sea-based missiles for deployment aboard the Arihant ballistic missile submarine. Finally, in cooperation with Russia, India developed the multiplatform Brahmos supersonic cruise missile with a range near 300 km, which is a conventional non-nuclear delivery system. Thus, India's growing missile capabilities are becoming one of the most important components of the Indian arsenal.

In terms of space-based capabilities, India has developed a formidable space program, highlighted by its 2019 ASAT test. It launched about 2-3 satellites each year in the 2000s and early 2010s, and about five each year in the late 2010s. Despite the overall success of its space program, it still trails far behind China, Russia, and the US in dedicated military satellites.[13]

Finally, in terms of UAV capabilities, India has focused on expanding its UAV use near its borders. India has already procured multiple units of the Israeli Heron and Hermes and may potentially acquire 30 US MQ-9 Reapers.[14] Together, India's UAV imports demonstrates that its UAV capabilities are not yet on par with those of China's.[15]

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[12] NASIC, Ballistic and Cruise Missile Threat, pp. 30-40.

[13] Shounak Set, "India's Space Power: Revisiting the Anti-Satellite Test," *Carnegie India*, September 6, 2019.

[14] "India plans to buy 30 MQ-9 Reaper drones for $3 billion from US company General Atomics," *Business Insider India*, March 10, 2020.

[15] Abhijnan Rej, "India's Drone Dreams – And Reality," *The Diplomat*, October 12, 2020.

In summary, these non-conventional arms are becoming of greater importance to security in the region and the expansion of power projection capabilities. The analysis and explanation of these growing capabilities can be the subject of future research.

5.3 Military Industrial Capacity

Two important observations can be made about how military industrial capacity influenced China and India's military modernization. First, a low level of military industrial capacity prevents significant indigenous military modernization and encourages these states to import foreign arms, though they may still license produce foreign arms. Second, military industrial capacity becomes a higher political priority when foreign arms suppliers are not widely available. Historically, low military industrial capacity has constrained indigenous arms development in China and India. In Periods 1-3 (1980-1994), low military industrial capacity demonstrates why these states seek foreign suppliers. In the case of China, this variable began to improve in the late-1990s and early 2000s. By 2010, China produced most of its MWS and subcomponents, with half considered to meet "modern" standards according to the Department of Defense. Likewise, their expanding arms exports demonstrate maturity and increasing international competitiveness.[16] This factor also underscores the significance of globalization is military industrial capacity. Even high-priority MWS in the US like the F-35 fighter aircraft have complex global supply chains. Thus, developing military industrial capacity inherently requires foreign technology acquisition.

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[16] Siemon T. Wezeman, Pieter D. Wezeman and Alexandra Kuimova, *Trends in International Arms Transfers, 2020* (Stockholm: SIPRI, March 2021).

5.3.1 Political and Economic Reforms of the Military Industrial Complex

Political and economic reforms of the military industrial complex were significant in China, which has implemented four distinct phases of structural reform within the military industrial complex since 1980. The last of these phases occurred in the late 1990s which overhauled much of the PLA's R&D apparatus.[17] Conversely, India did not implement substantive political and economic reform within the military industrial complex until after 2000. These reforms included opening to private and foreign investment within the military industrial complex and a re-emphasis on co-production. Overall, India's military industrial reforms have been limited and have ignored many of the larger structural factors inhibiting military R&D, including a lack of competition, foreign technology infusion, and over-centralization.

5.3.2 Human Capital

Inadequate human capital was a consistent constraint in developing military industrial capacity in China and India. Long-term recruitment, training, and retention of engineers and technicians remain a challenge for both cases. This factor has improved in China since 2000 but remains a core inhibitor in India. Progress in China is demonstrated by the substantial growth in STEM degrees, higher education institutions, patents, publications, and national retention. Some of this progress is driven by China's national initiatives such as the Thousand Talents Plan, some of which are also designed to attract Chinese students studying overseas to return to China. Conversely, India continues to struggle with expanding access to secondary and tertiary

[17] Patrick Thibodeau, "China Set to Surpass US in R&D Spending in 10 Years," *Computer World*, December 24, 2012.

education and while it remains a leader in awarding STEM degrees it suffers from significant emigration ("brain drain") and low retention, a further consequence of globalization.[18]

5.3.3 The Issue of Systemic Military Industrial Espionage

In the literature on rising regional powers and defense innovation, espionage has, historically, been a marginal factor. Thus, this it was excluded from extensive analysis at the onset of this study. However, this study has identified systemic military industrial espionage as a likely contributor to China's dramatic military modernization growth. In light of limited access to foreign arms suppliers, fears over military technological inferiority, and growth in US military capabilities, China almost certainly pursued a deliberate campaign of systemic military industrial espionage to uncover not only foreign intelligence but to also advance its own military industrial capacity.[19]

According to the Federal Bureau of Investigation (FBI), nearly half of the Bureau's 5,000 open intelligence cases are related to China.[20] Between 1997 and 2016, one survey of cases tried against the US Espionage Act found that over 100 were connected to China.[21] In contrast,

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[18] Shreyasi Singh, "Can India Plug its Brain Drain," *The Diplomat*, September 5, 2013.

[19] See for instance David Wise, *Tiger Trap: America's Secret Spy War with China* (New York, N.Y.: Houghton Mifflin Harcourt Publishing, 2011); Peter Mattis and Matthew Brazil, *Chinese Communist Espionage: An Intelligence Primer* (Annapolis, MD: U.S. Naval Institute Press, 2019); and Bill Gertz, *Deceiving the Sky: Inside Communist China's Drive for Global Supremacy* (New York, N.Y.: Encounter Books, 2019).

[20] Christopher Wray, "The Threat Posed by the Chinese Government and the Chinese Communist Party to the Economic and National Security of the United States," remarks delivered to the Hudson Institute (Washington, D.C.: July 7, 2020).

[21] Mattis and Brazil, *Chinese Communist Espionage*, pp. 145-194.

analysis of the US Department of Justice's summary of economic espionage cases from 2009-2019 only identifies three cases connected to India.[22]

But as noted earlier in this study, there are several limitations to assessing the scope and impact of industrial espionage. While it is well-documented that China was the source of *many* cyber-thefts directed against US and European defense contractors and Department of Defense-sponsored research institutes, the actual number of cases and what was stolen is typically unknown. Likewise, it is unclear how useful or easily the stolen technology was assimilated, let alone compatible with PLA systems. And while China possesses one of the most sophisticated reverse-engineering programs in the world as demonstrated by its successful replication of numerous Russian and American MWS, it is not easy to compute the extent to which espionage contributed to this reverse-engineering.

This issue raises another question: to what extent do democracies and allies spy on each other, let alone commit systemic military industrial espionage? Why was China far more aggressive in leveraging espionage, particularly cyber espionage, than India? The scale of China's apparent massive cyber espionage campaign against the US stands in stark contrast to India's nearly total (at least apparent) absence in this realm. It could be that India has chosen not to pursue such a strategy so as not to antagonize its defense suppliers. India may also concentrate its limited resources and espionage efforts against regional threats, including China and Pakistan—though these may aim to get knowledge about the adversary's military capabilities rather than to reverse-engineer their capabilities. Lastly, India may not deem military industrial espionage necessary given its access to a wide range of foreign arms suppliers and technology.

[22] US Department of Justice, Summary of Major U.S. Export Enforcement, Economic Espionage, Trade Secret and Embargo-Related Criminal Cases (January 2009 to February 2015, and January 2016 to January 2019) (Washington, D.C.: Department of Justice), pp. 1-93, and 1-51.

5.4 Foreign Supply

Two observations can be made about the impact of foreign supply on China's and India's military modernization. First, a lack of foreign suppliers constrains military modernization goals by inhibiting the diffusion of advanced military technology that cannot otherwise be developed indigenously. Lower availability results in greater emphasis on domestic R&D as well as unconventional technology acquisition (espionage). China's ability to exploit Western security weaknesses through espionage and cyber theft allowed it to close technological gaps by bypassing critical R&D steps and investment. This variable exerted greater influence on China than India, particularly in the 1980s and 1990s (Periods 1-4 in this study). Since 2000, however, China has proven capable at bypassing foreign technology embargoes and military technology control regimes.

Second, import-substitution policies inadvertently block foreign technology acquisition, which is essential to military industrial capacity. This policy dynamic is counterintuitive but remains an important inhibitor to developing military industrial capacity in India. The inability to acquire and integrate foreign technology is one reason for the consistent delays in India's indigenous arms programs.

5.5 Military Obsolescence

Two observations can be made about how military obsolescence influenced China's and India's military modernization. First, military obsolescence is associated with weak military industrial capacity. In both cases, military obsolescence in many weapon systems developed following delays or failed attempts to field indigenous MWS. This result was frequently followed by block orders of foreign arms to fill gaps in capabilities. Second, military obsolescence was treated differently in China and India, correlating with differences in the security threat environment. In China, military obsolescence was tolerated to a high degree between 1980 and 2000. The Chinese mainland faced few imminent threats throughout this period thus limiting the necessity to field state-of-the-art MWS. However, by 2000, large percentages of the PLA's key MWS were considered technologically obsolete or too old to maintain.[23] Conversely, India was more attentive to changes in the balance of power with Pakistan, placing a higher premium on deploying state-of-the-art MWS. As a result, India had greater difficulty accepting higher levels of technological obsolescence which impacted its approach to procuring arms through its available foreign arms suppliers since its domestic military industrial capacity could not meet expectations.

5.6 Security Threat Environment

As this study demonstrated, the security threat environment is the most influential factor in promoting military modernization in both China and India. In India, this variable operated strongest in Periods 1, 5, and 8—the early 1980s, the early 2000s, and the late 2010s. In Periods 1 and 5, Indian military modernization was influenced by major advancements and provocations in Pakistan. In Period 8, Indian defense planners had identified growing Chinese military capabilities as the greatest threat to India's interests. Figure 5.3 demonstrates that China's national capabilities have exponentially increased in comparison to India.

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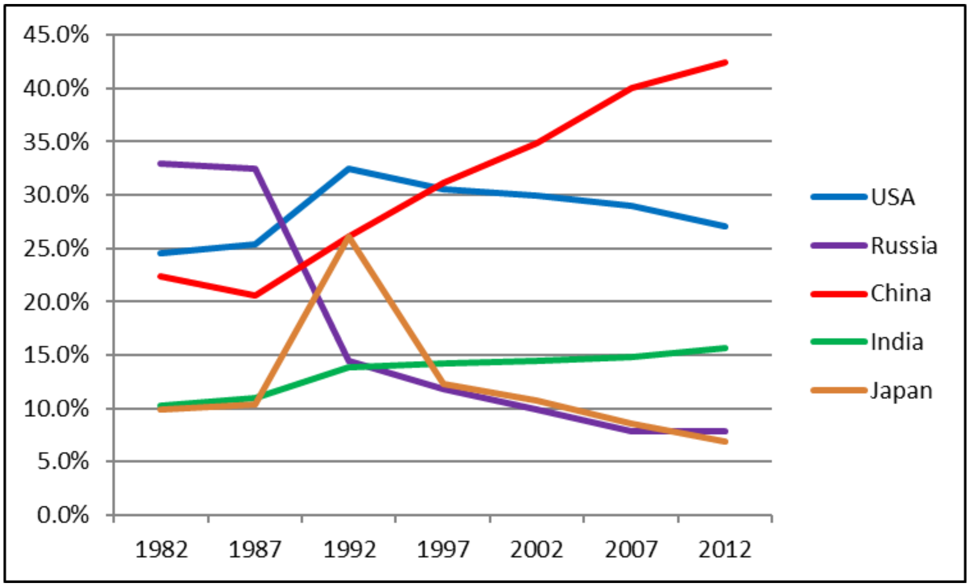
[23] Office of the US Secretary of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China*, 2001 (Washington, D.C.: Department of Defense, 2001).

Figure 5.3 CINC Summary



Unlike India, China experienced a less threatening security threat environment in Periods 1-3 (the 1980s and early 1990s). The security threat environment was more favorable to China, in terms of a lower threat environment, until 1995 when Sino-US tensions rose as result of the Taiwan Strait Crisis. In the 2010s, the threat environment has remained high due to tensions over resources in the South China Sea and a "pivot" of American interest towards Asia. This variable ultimately reveals that high threat environments have correlated with increased military modernization. Likewise, lower threat environments have experienced lower or static military modernization. Since the late 1990s, higher threat environments have been followed by greater political emphasis on military modernization and ultimately annual double-digit increases in defense spending.

5.7 Interaction of Variables

This study also observes and emphasizes the importance of four interactions. First is between foreign supply and military industrial capacity, which is observed in both cases. In

China, the interaction was expressed in the shortage of foreign suppliers, which both incentivized the need for better military industrial capacity and constrained the absorption of foreign technology. This interaction contributed to a high priority placed on military industrial capacity. In India, the interaction was expressed in the dominant role of Russia as India's primary arms supplier, thus relegating indigenous arms development. This interaction had a negative influence on military modernization in India.

The second interaction is between foreign supply and military obsolescence. In China. the interaction was expressed in the lack of foreign suppliers willing to export MWS and technology. This left Chinese leaders in a precarious situation, having to choose between intensive military industrialization or maintaining the existing force structure. This interaction had a negative influence on military modernization. India, on the other hand, had an abundance of available foreign suppliers which gave it the ability to quickly procure foreign arms to fill stopgaps and avoid critical situations of military obsolescence. In the case of India, this interaction was particularly salient due to India's tensions with Pakistan. India's security competition vis-à-vis Pakistan was more intense than China's regional security competition, and India capitalized on its access to foreign arms at critical moments. However, India's access to more foreign suppliers produced mixed results in some cases, particularly in the instance of the failed Medium Multirole Combat Aircraft (MMRCA) competition.

The third interaction is between foreign supply and the security threat environment in China and India. In many cases, heightened tensions or international crises are followed by political actions, including economic sanctions and arms embargoes. In China, the interaction was expressed by the Sino-Soviet split and Western arms embargoes following the 1989 Tiananmen Square crisis. This interaction had a negative influence on military modernization. In

India, the interaction was expressed briefly following a series of nuclear weapons tests in 1998. The tests were followed by international condemnation and US sanctions, which were later removed by the end of 2001. This interaction had a negative influence on military modernization.

The fourth interaction is between military industrial capacity and military obsolescence. In many cases, the prevalence of military obsolescence is traced back to the inadequacies of the military industrial complex and delayed indigenous arms. In China, the interaction was expressed in the slow pace of military industrialization throughout the 1980s and 1990s which resulted in years of delays for key MWS. This interaction had a negative influence on military modernization. In India, the interaction was expressed in the inadequacies of the military industrial complex to develop reliable and timely MWS. On several occasions, Indian defense planners were forced to operate obsolete arms as indigenous arms programs were continuously delayed, sometimes indefinitely. This interaction had a negative influence on military modernization.

5.8 Conclusion

This dissertation addresses several gaps in the literature pertaining to these two countries. While most military studies focus on Western and Russian development, few study the military modernization and capabilities of China and India in relation to their parallel rise. As shown in this dissertation, both China and India are growing international powers and should not be discounted, and a comparison of their respective military modernization yields several key insights.

Three key conclusions can be discerned from this study. First, each of the four factors examined in this study impacted military modernization in China and India in different ways;

however, the degree and timing of this impact varied. The security threat environment, for example, changed considerably between 1980 and 2018. The proximate threat for China changed from non-specific to the US; and for India it changed from a primary threat from Pakistan to a dual threat from both China and Pakistan. This contributed to the trends in both states to transition from low to high military modernization as discussed in this study. Second, changes in the security threat environment have historically exerted the strongest influence on military modernization. Rapid increases in military expenditure and procurement have frequently coincided with higher regional instability. In addition, the security threat environment variable created increased urgency within political circles at certain times leading to increases in military modernization. These conditions are likely compounded by expanding globalization and centralization of the global arms industries. This is also true of international human capital migrations which have an important role in military industrial capacity. China has likely exploited the latter factor more effectively than India which possesses a large diaspora of its highest educated populations. Many of China's talent programs are targeted at Chinese students studying abroad to incentivize them returning to China. Finally, China's military modernization was, and will inevitably continue to be, larger and disproportionate to India's because of its larger economy and defense budget. Additionally, China's aggressive strategy of technology transfer and intellectual property theft likely gives it significant advantages in military industrial capacity, but this factor is difficult to investigate, and beyond the scope of this study.[24]

[24] For more on China's leveraging of talent programs for industrial espionage, see Ellen Barry and Gina Kolata, "China's Lavish Funds Lured U.S. Scientists. What Did It Get in Return?" *The New York Times,* February 6, 2020; Ryan Fedasiuk and Jacob Feldgoise, *The Youth Thousand Talents Plan and China's Military*, CSET Issue Brief (Washington, D.C.: Center for Security and Emerging Technology, August 2020); and Stephen Chen, "America's Hidden Role in Chinese Weapons Research," South China Morning Post, March 29, 2017.

Nonetheless, this study advances four major contributions to the study of military modernization and to the cases of China and India. First, it advances a broader framework for systematically analyzing military modernization over an extended period of time. The selection of multiple contributing variables and indicators yield better insights than analysis of selective MWS or short time periods. Second, the selection of China and India as case studies reveals improved insights about rising states and how their military modernization policies shift over time, particularly in relation to globalization. This study illustrates that regional powers like China and India often have complex economic and security situations to balance, both domestically and internationally. Even though the production of key MWS has centralized in the hands of a few states, globalization has expanded access to key military technology information. While some argue that globalization may enhance stability in some areas, it has increased competition in many areas as the issue of cyber espionage demonstrates.[25] Third, it reinforces the significance of the security threat environment as a key causal variable in defense planning. But as the interactions of the variables demonstrates, this is not always straight-forward. In the case of China, low security threat concerns in the 1980s prompted less priority for military industrial capacity and enabled higher military obsolescence. This changed in the 1990s and 2000s as the security threat calculus shifted. Higher security concerns influenced prioritization of military industrial capacity, and indigenous military industrial was also necessary due to the low or unreliable availability of foreign arms suppliers. In the case of India, intense security competition vis-à-vis Pakistan dictated high demand for state-of-the-art weaponry. Because India's military industrial capacity could not meet this standard, and to mitigate military obsolescence in the face of a security threat, India had to procure foreign arms at high levels. Finally, this study has

[25] Stephen G. Brooks, *Producing Security: Multinational Corporations, Globalization, and the Changing Calculus of Conflict* (Princeton, N.J.: Princeton University Press, 2005); pp. 1-15.

revealed that the impact of illicit and coercive technology transfer is likely an important factor in China's military modernization program. While there are many challenges to effectively exploiting intelligence collection and large-scale technology transfer, China appears to have transformed it into a formal scientific endeavor. By some estimates, China's activities in this realm represent "the greatest transfer of wealth in history."[26]

Additionally, there appears to be a bias in the international security literature that downplays China's ability to innovate high-technology. Studies point to China's propensity to imitate most technologies rather than develop their own.[27] Others have further argued that there are serious limitations to reverse-engineering products.[28] Yet, China has arguably overcome most of these challenges, and many key examples or milestones of technological imitation need further analysis. Perhaps the biggest breakthrough in China's technological development is demonstrated not by MWS but by its space program. During the height of the space race, the US and the Soviet Union each launched dozens of missions (with *many* failures) to land on the moon, operate a space station, operate a reusable space plane (manned or unmanned), and land on Mars. The Soviet Union was first in most milestones—it landed on the moon in 1959 (uncontrolled landing) and 1966 (controlled landing), operated a space station in 1971, successfully (partially) landed on Mars in 1971, and launched a reusable orbital space plane

[26] Dennis C. Blair and Keith Alexander, "China's Intellectual Property Theft Must Stop," *The New York Times*, August, 15, 2017.

[27] Stephen G. Brooks and William C. Wohlforth, William, "The Once and Future Superpower: why China won't overtake the United States," *Foreign Affairs* (May/June 2016), pp. 91-104.

[28] Andrea Gilli and Mauro Gilli, "Why China Has Not Caught Up Yet: Military-Technological Superiority and the Limits of Imitation, Reverse Engineering, and Cyber Espionage," *International Security*, Vol. 43, No. 3, (Winter 2018/2019), pp. 141-189.

(unmanned) in 1988.[29] The US achieved each milestone in 1969, 1973, 1975, and 1981, respectively. China, on the other hand, has achieved each of these objectives within the span of *one* year between July 2020 and June 2021. And it did so with a nearly flawless record.[30] In contrast, the European Space Agency, as of this writing, has *never* successfully achieved any of the aforementioned milestones. Thus, underestimating the potential for either Chinese or Indian technology innovation may be a cause for strategic surprise in future conflicts.

In sum, this dissertation illustrates the complex nature of military modernization. It also offers important insights and lessons from its analysis of rising regional state powers. The insights and lessons drawn from China's and India's parallel, yet different, paths of development and military modernization can inform analysis and policy on future defense modernization in these states, and possibly others, and such modernization could significantly influence security in Asia and US security policy in Asia.

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[29] The Soviet Union's 1971 Mars landing is considered a partial success since it successfully completed a soft landing and transmitted at least one image, but it quickly lost contact in less than one minute and never recovered.

[30] China's lone failed mission among these milestones, the Yinghuo-1 Mars orbiter, failed due to a rideshare on a failed Russian launch in 2011.

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