ESTIMATING CHINA'S DEFENSE SPENDING: HOW TO GET IT WRONG (AND RIGHT)

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China's defense spending is opaque, and China spends more on defense than its official 2024 defense budget of 1.67 trillion yuan ($232 billion) indicates. Some analysts claim China's defense spending is equivalent to $700 billion, approaching the level of the U.S. defense budget. These estimates mistakenly exaggerate China's spending. They rely on unbalanced accounting for so-called off-budget expenditures and employ flawed purchasing power parity methods. We explain these flaws and offer a novel method for a more accurate assessment. According to our calculation, China will spend an estimated $471 billion on defense in 2024, or around 36 percent of comparable U.S. defense spending of about $1.3 trillion in 2024. A better understanding of Chinese defense spending enables U.S. policymakers and military planners to make more informed resourcing and allocation decisions while reducing the likelihood of overreaction and miscalculation.

Is China catching up to the United States in defense spending? At early 2024 market exchange rates, China's 2024 official defense budget of 1.67 trillion yuan is equivalent to $232 billion.[1] In comparative terms, this is less than one-third of the 2024 U.S. Department of Defense budget of $825 billion.[2] Careful analyses of Chinese military spending conclude that Beijing actually spends more than its official defense budget would suggest.[3] These studies find that its spending has been 27 percent to 33 percent higher than the official figures in recent years. Using this range as a guide would indicate that China's 2024 defense spending is about $295 billion to $309 billion.[4]

Yet some analysts have recently argued that China's defense spending is much larger still, and their new numbers have gained the attention of wider audiences.[5] *The Economist* has reported that China's defense spending has already reached two-thirds

1 "China's defense expenditure is open, transparent, reasonable and appropriate, with an increase of 7.2% over the previous year [中国国防费公开透明 合理适度 比上年执行数增长7.2%]." People's Republic of China Ministry of Defense, March 9, 2024, http://eng.mod.gov.cn/xb/News_213114/TopStories/16292566.html. At 7.2 percent growth over 2023, China's official 2024 defense budget is growing faster than the U.S. Department of Defense budget, particularly on an inflation-adjusted basis due to recent high inflation in the United States and relatively low inflation in China. China's 2024 defense budget growth was also higher than its targeted gross domestic product growth (5 percent), raising questions about the sustainability of defense spending growth. In 2024, official defense budget growth was lower than the growth rate of the total Chinese central government budget for 2024 (7.8 percent).

2 "Congress Passes $825 Billion Defense Spending Bill Amid Political Battles, Government Shutdown Threat," *Real Clear Defense*, March 23, 2024, https://breakingdefense.com/2024/03/congress-passes-825-million-defense-spending-bill-amid-political-battles-government-shutdown-threat/; "Department of Defense Appropriations Act 2024," U.S. House of Representatives, March 18, 2024, https://docs.house.gov/billsthisweek/20240318/Division%20A%20Defense.PDF.

3 The Stockholm International Peace Research Institute (SIPRI), *SIPRI Military Expenditure Database*, estimates spending for 2022 to be 27 percent higher than the official figures for that year, while the International Institute for Strategic Studies (IISS), *The Military Balance 2022*, puts the figure for 2021 at 33 percent higher than the official figure. For the methodologies employed by those organizations, see Meia Nouwens, *Assessing Chinese Defence Spending: Proposals for New Methodologies*, IISS, March 2020, https://www.iiss.org/research-paper//2020/03/assessing-chinese-defence-spending; and Nan Tian and Fei Su, *A New Estimate of China's Military Expenditure*, SIPRI, 2021, https://www.sipri.org/publications/2021/other-publications/new-estimate-chinas-military-expenditure.

4 As yet, neither SIPRI nor IISS have released 2024 estimates for total Chinese defense spending. This implied range is based on China's 2024 official budget and the range of recent SIPRI and IISS estimates for 2021 and 2022.

5 Mackenzie Eaglen, *Keeping Up with the Pacing Threat: Unveiling the True Size of Beijing's Military Spending*, American Enterprise Institute, April 29, 2024, https://www.aei.org/research-products/report/keeping-up-with-the-pacing-threat-unveiling-the-true-size-of-beijings-military-spending/; Robert Peters and Wilson Beaver, "The Defense Department's China Military Power Report: The Threat Is Worse than Advertised," *Real Clear Defense*, January 29, 2024, https://www.realcleardefense.com/articles/2024/01/29/the_defense_departments_china_military_power_report_the_threat_is_worse_than_advertised_1008012.html; Wilson Beaver, *Cold War Lessons for Estimating the Chinese Defense Budget*, The Heritage Foundation, January 12, 2024, https://www.heritage.org/sites/default/files/2024-01/BG3805.pdf; Peter Robertson, "China's Defense Budget Is Much Bigger Than It Looks," *Foreign Policy*, September 19, 2023, https://foreignpolicy.com/2023/09/19/china-defense-budget-military-weapons-purchasing-power/; Frederico Bartels, *China's Defense Budget in Context: How Under-Reporting and Differing Standards and Economies Distort the Picture*, The Heritage Foundation, March 2020, https://www.heritage.org/asia/report/chinas-defense-budget-context-how-under-reporting-and-differing-standards-and-economies. Bartels concludes that "China's defense spending is 87% the size of the U.S.'s." See also Peter Robertson, "China's Military Might Is Much Closer to the U.S. Than You Probably Think," *The Conversation*, October 1, 2019, https://theconversation.com/chinas-military-might-is-much-closer-to-the-us-than-you-probably-think-124487; Peter Robertson, "International Comparisons of Real Military Purchasing Power: A Global Database," The University of Western Australia, Discussion Paper 19.13, 2019, https://research-repository.uwa.edu.au/en/publications/international-comparisons-of-real-military-purchasing-power-a-glo.

of U.S. spending and is "catching up quickly."[6] Then-Chairman of the Joint Chiefs of Staff Gen. Mark Milley told Congress in 2021 that "the Russian and Chinese budgets exceed our budgets if all the cards are put on the table."[7] In September 2023, U.S. Sen. Dan Sullivan claimed that China's defense spending is "probably close to about $700 billion" — three times higher than Beijing's official defense budget.[8] Apparently worried that China is poised to match or even surpass U.S. spending, Congress introduced legislation in June 2023 calling for the development of new methods for measuring, comparing, and reporting on China's defense spending.[9]

Estimating the value of adversary spending on defense has never been easy.[10] China's defense spending has been the subject of intense scrutiny.[11] However, gaps in research and policy analysis persist, particularly with respect to estimating defense-related spending not included in China's official defense budget ("off-budget spending") and how to convert Chinese spending in Chinese currency to a comparable U.S. dollar equivalent. In this article, we outline a method for more accurately assessing China's defense spending. We include comparable spending categories for both the United States and China and apply appropriate means for currency conversion.

Contrary to estimates that China spends nearly $700 billion annually on defense, we estimate that China's 2024 defense spending is equivalent to about $471 billion*, compared to U.S. 2024 defense spending of about $1.3 trillion.[12] We show that off-budget items comprise a similar percentage of defense spending in both China (30 percent) and the United States (31 percent to 36 percent, depending on how spending by the Department of Homeland Security is treated).

Any estimate is highly dependent on assumptions about what should be included, what should be excluded, and how exchange rates should be treated. Although we provide a single estimate to illustrate our approach, that estimate falls within a plausible range of figures that might vary according to specific choices about which spending categories to measure, and how. Therefore, our most important contribution is to present a set of transparent, reasonable assumptions and calculations that can be evaluated by others seeking to understand what China spends on defense and how to compare that to spending by other countries.

We also show how to avoid getting it wrong. The highest estimates of China's defense spending involve two adjustments to its official defense budget. Both adjustments could produce reasonable results — but only if correctly and consistently applied. The first is to supplement China's official defense budget with off-budget items that contribute to China's defense. The second is to adjust China's spending in its local currency, the yuan, for purchasing power parity (PPP). The PPP adjustment is meant to reflect the Chinese currency's ability to purchase more domestic goods and labor than its market exchange rate (MER) would suggest.

Making these adjustments is difficult, and getting either one wrong can produce significant errors. Recent high estimates that suggest China is on the cusp of overtaking U.S. defense spending get both wrong. First, they do not compare like-for-like off-budget items between the two countries. Cherry-picking spending categories and omitting areas where the United States spends more than China is a common problem.[13] Second, some estimates misuse PPP to excessively inflate spending categories where China's defense economy has cost advantages, while mis-

6 "Nominal spending figures understate China's military might," *The Economist*, May 1, 2021, https://www.economist.com/graphic-detail/2021/05/01/nominal-spending-figures-understate-chinas-military-might.

7 Stenographic Transcript Before the Committee on Armed Services, U.S. Senate, June 10, 2021, https://www.armed-services.senate.gov/imo/media/doc/21-49_06-09-21021.pdf.

8 James Stavridis, "China's military spending is much bigger than we thought: revised figures based on U.S. intelligence give an estimate of $700 billion a year instead of the official figure of $300 billion," *Bloomberg*, September 13, 2023, https://www.bloomberg.com/opinion/articles/2023-09-13/china-spends-700-billion-on-its-military-approaching-us-900-billion; Congressional Record, Proceedings and Debates of the 118th Congress, First Session, vol. 169, no. 95, S1895, https://www.congress.gov/118/crec/2023/06/01/169/95/CREC-2023-06-01-senate.pdf#page=9; Matthew Hipple, "Chinese Defense Spending Is Bigger than America's," *The National Interest*, November 2, 2023, https://nationalinterest.org/blog/buzz/chinese-defense-spending-bigger-americas-207141; Mackenzie Eaglen, "China's Real Military Budget Is Far Bigger Than It Looks," *19FortyFive*, June 16, 2023, https://www.19fortyfive.com/2023/06/chinas-real-military-budget-is-far-bigger-than-it-looks/

9 China Defense Spending Transparency Act, https://www.romney.senate.gov/wp-content/uploads/2023/06/ChinaDefenseSpendingTransparencyAct.pdf.

10 The challenges associated with estimating such spending vary from case to case. During the Cold War, the CIA had no Soviet national-level data. The CIA dealt with the problem by observing military equipment and activities, and estimating how much the equipment or activity would cost if produced or conducted in the United States. Central Intelligence Agency, National Foreign Assessment Center, *A Dollar Cost Comparison of Soviet and U.S. Defense Activities, 1966–76*, October 1977, https://www.cia.gov/readingroom/docs/DOC_0000498557.pdf.

11 By mandate of Congress, the U.S. Department of Defense produces an annual report on Chinese military power, which includes analysis of defense spending. The first edition appeared in 2000, https://apps.dtic.mil/sti/citations/ADA381499. A 2005 report by the RAND Corporation offered improved analysis including greater use of Chinese-language source material; see Keith Crane et al., *Modernizing China's Military: Opportunities and Constraints*, https://www.rand.org/content/dam/rand/pubs/monographs/2005/RAND_MG260-1.pdf. Both SIPRI and IISS publish annual assessments of Chinese defense spending.

12 We provide details of these estimates in later sections of this paper. We exclude nuclear weapons (fissile material) programs, space programs, and national intelligence programs for both countries.

13 Bartels, *China's Defense Budget in Context*.

takenly applying PPP adjustments to those spending categories where it does not.[14]

Some of these calculations lead to conclusions that defy common sense. China's defense spending is purported to be larger (and implicitly more threatening) because China is a developing country with cost advantages in labor-intensive sectors. This emphasizes the importance of labor-intensive military capabilities and equipment, counter to the modern military emphasis on much more lethal capital- and technology-intensive systems. It also appears to run counter to the established strategy of China's People's Liberation Army of waging "informatized wars." That strategy requires a less manpower-intensive and more technology-intensive force. Nor does China appear to have the actual material capabilities — numbers and quality of ships, planes, and other major systems — that it should possess if its defense spending was on par with U.S. defense spending.

Like should be compared to like, and categories should not be cherry-picked to exaggerate differences.

China's relative material capabilities — economic, technological, and military — plus its growing expenditure on defense, make it the country most capable of challenging American interests. However, America must manage multiple international security challenges and important domestic budget requirements as well. An accurate picture of how much China spends on its military is essential to help ensure that Washington invests in appropriate military capabilities to deter and if necessary defeat potential threats from Beijing. Underestimating China's defense spending could lead to underinvestment in capabilities required to counter China. Exaggerating that spending could lead the United States to misallocate resources, focus on the wrong threats, or respond in ways that exacerbate security dilemmas in the Indo-Pacific.

We start by pointing out the pitfalls common to many analyses of China's defense spending, with a focus on off-budget spending and PPP calculations. We next discuss four specific problems involving PPP calculations. These problems have led to greatly inflated estimates of Chinese spending. We then introduce our own estimate, which is based on comparing similar budget items for both China and the United States and uses tailored PPP conversion factors for the personnel, operations, and equipment portions of China's defense spending. We conclude by discussing the implications of our analysis for U.S. national security policymaking.

Official Budgets and Off-Budget Spending

All countries omit important elements of their defense-related expenditure from their official defense budgets. When comparing Chinese and U.S. defense expenditure, the same spending categories should be included on both sides of the ledger — often, they are not. For example, China's People's Armed Police and its Coast Guard are not included in China's official defense budget. Many analysts argue they should be included in overall defense spending estimates.

However, if spending for these forces is included, then similar items should be added to the total for the United States when comparing the two budgets.[15] The U.S. Coast Guard budget is held by the Department of Homeland Security, not the Department of Defense, so for comparison that spending should be added to the Defense Department's budget. The Department of Homeland Security also conducts counter-terrorism activities and thus contributes to U.S. national security, so other elements of its budget might also be included. Likewise, many analysts argue that social welfare support, benefits, and payments to People's Liberation Army veterans should be included in the Chinese total.[16] For an accurate comparison, this should be matched by adding similar spending on healthcare and other benefits to veterans from the Department of Veterans Affairs to the U.S. total.

Counting errors have also been made in estimating defense research and development expenditure. The Defense Department and many recent studies all argue that China's official military budget does not include all defense-related spending, such as

14 Robertson, "China's Military Might Is Much Closer to the U.S. Than You Probably Think"; Robertson, "International Comparisons of Real Military Purchasing Power." Also, see Jacqueline Deal, "China could soon outgun the U.S.," *Politico*, May 27, 2021, https://www.politico.com/newsletters/politico-china-watcher/2021/05/27/china-could-soon-outgun-the-us-493014; Bill Greenwalt, "China Already Outspends U.S. Military? Discuss," *Breaking Defense*, May 26, 2021, https://breakingdefense.com/2021/05/china-already-outspends-us-military-discuss/.

15 Studies that include spending on the People's Armed Police and Coast Guard for China but do not include similar spending for the United States are Robertson, "International Comparisons of Real Military Purchasing Power"; Beaver, *Cold War Lessons for Estimating the Chinese Defense Budget; and Bartels, China's Defense Budget in Context.*

16 Beaver, *Cold War Lessons for Estimating the Chinese Defense Budget; Bartels, China's Defense Budget in Context*; Robertson, "International Comparisons of Real Military Purchasing Power"; Nouwens, *Assessing Chinese Defence Spending*; Tian and Su, *A New Estimate of China's Military Expenditure.*

defense-related research and development.[17] Some estimates have attempted to deal with this problem by not counting defense research and development expenditure at all. Yet one prominent 2020 study by Federico Bartels from the Heritage Foundation subtracts the research and development component from the Department of Defense budget, but it then compares the reduced U.S. defense spending number to an estimate for China that was enlarged by the addition of off-budget Chinese spending on military-related research and development.[18]

The core principles are simple: Like should be compared to like, and categories should not be cherry-picked to exaggerate differences. These principles are often ignored, especially by those who seek to depict Chinese defense spending as on par with or rapidly approaching U.S. levels. Any legislation Congress may adopt to assess Chinese military spending could have far-reaching influence by defining the methods of analytical tradecraft for years to come. The June 2023 draft of the China Defense Spending Transparency Act calls for including "military-civil fusion" items for China but not for the United States, excluding veterans' benefits other than pensions (which is a large component of total U.S. defense-related spending), and requires consideration of defense-related expenditures by Chinese state-owned enterprises — without also accounting for defense-related expenditures by any element of U.S. industry.[19] The provisions of this measure thus have the potential to obscure the stated "transparency" goal of the legislation's name.

Purchasing Power Parity Adjustments: Unbalanced and Error-prone

The second modification often used to estimate China's defense spending is to account for the relative purchasing power of China's currency using a PPP adjustment. This is potentially useful because price levels in developing economies tend to be lower than price levels in developed economies, where higher productivity is translated into higher wages and prices.[20] In a lower- or middle-income economy, the costs of goods such as food, clothing, or concrete are largely determined by (lower) local prices and wages. These items tend to be labor-intensive rather than capital- and technology-intensive. Since a bowl of rice, a t-shirt, or a cubic yard of concrete are essentially the same products in all economies, the purchasing power for these goods (and the level of domestic economic welfare) in a lower-income economy is often higher than that implied by market exchange rates. PPP exchange rates thus attempt to convert prices for equivalent goods across economies into a common currency unit that eliminates the effect of different economic development and price levels.

However, PPP estimates also have limitations. PPP exchange rate estimates were not developed to measure internationally competitive and tradable goods, services, and technologies, or goods largely comprised of components and technologies that are internationally traded, such as high-end semiconductors and aircraft engines.[21] The cost of these items is largely determined by international prices, both because international trade involves international financial flows (settled at market exchange rates) and because internationally traded goods are exposed to cost input and price competition across multiple markets.[22] Market exchange rates generally better reflect purchasing power for these goods.

The most commonly used PPP exchange rates are based on field surveys done by the International Comparison Program and published by the World Bank. The most recent detailed estimate for China was published in 2020 and is based on data collected in 2017.[23] In that report, the broadest measure for a PPP exchange rate for gross domestic product (GDP; i.e., all sectors of the economy) was 4.2 yuan to one

17 U.S. Department of Defense, *Military and Security Developments Involving the People's Republic of China*, October 2023, https://media.defense.gov/2023/Oct/19/2003323409/-1/-1/1/2023-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA.PDF; Beaver, *Cold War Lessons for Estimating the Chinese Defense Budget*; Bartels, *China's Defense Budget in Context*; Robertson, "International Comparisons of Real Military Purchasing Power"; Eaglen, *Keeping Up with the Pacing Threat*; Stavridis, "China's military spending is much bigger than we thought."

18 Bartels, *China's Defense Budget in Context*. Bartels uses a SIPRI estimate for China's defense spending that includes additions for defense research and development. For a detailed discussion of what is included in SIPRI's data (including for past years), see Tian and Su, *A New Estimate of China's Military Expenditure*. See also, Frederico Bartels, "Persistent Knowledge Gaps in the Chinese Defense Budget," *Joint Force Quarterly* 105, April 14, 2022, https://ndupress.ndu.edu/Media/News/News-Article-View/Article/2999183/persistent-knowledge-gaps-in-the-chinese-defense-budget/.

19 China Defense Spending Transparency Act.

20 Paul Samuelson, "Theoretical Notes on Trade Problems," *Review of Economics and Statistics* 46, no. 2 (May 1964): 145–54; Bela Balassa, "The Purchasing Power Parity Doctrine: A Reappraisal," *Journal of Political Economy* 72, no. 6 (December 1964): 584–96.

21 World Bank International Comparison Program, *Global Purchasing Power Parities and Real Expenditures: 2005 International Comparison Program Methodological Handbook*, https://thedocs.worldbank.org/en/doc/992361487994105283-0050022017/original/2005handbook.pdf; Organisation for Economic Cooperation and Development (OECD), *Eurostat-OECD Methodological Manual on Purchasing Power Parities*, November 2012, https://www.oecd-ilibrary.org/docserver/9789264189232-en.pdf?expires=1694495430&id=id&accname=guest&checksum=F70712572EB9C6BC2D3AB7D2422DCCCE.

22 World Bank, *PPPs for Policy Making: A Visual Guide to Using Data from the ICP*, International Comparison Program Briefs, June 10, 2021, https://openknowledge.worldbank.org/entities/publication/dc4deba0-339b-5dca-af4c-4881445d1dce, especially 3–6.

23 World Bank International Comparison Program 2017, https://databank.worldbank.org/source/icp-2017.

U.S. dollar.[24] The market exchange rate that year averaged approximately 6.8 yuan per dollar. So by the very broad measure of PPP-adjusted GDP, the purchasing power of the yuan was 1.6 times greater than what was implied by the MER. The World Bank also produces sector-level PPP exchange rates that estimate price levels for food, transportation, housing, consumption, total investment in capital goods (i.e., capital formation), and various other sectors.[25]

Although PPP arguably should be applied to defense spending, doing so requires careful consideration of how the PPP adjustments relate to real-world inputs and outputs. Any PPP exchange rate that is used should correspond — within reasonable bounds — to the spending category under consideration. The World Bank's methodological guidelines for the use of PPP methods should be followed to ensure that the products under consideration are comparable.[26] The recent high-end estimates of Chinese defense spending fail in this regard.[27]

Despite the differences in PPP data across different sectors of the economy, some estimates of Chinese defense spending use a single economy-wide PPP exchange rate, which inflates China's entire defense budget.[28] This is misleading because any defense budget includes a mix of domestic labor-intensive components on one hand, and internationally traded or capital-intensive components on the other. If PPP exchange rates are used, these different components of defense spending should be estimated using the appropriate PPP exchange rate.

Notably, in the case of developing economies, PPPs can also reflect lower relative purchasing power than market exchange rates for capital- and technology-intensive goods. This can occur where there are trade barriers for such goods, or where the cost of barriers to entry or learning curves must be overcome. The most recent World Bank PPP data show that China's PPP exchange rate for machinery and equipment is 9.3 yuan per dollar (table 1).[29] Unlike the overall GDP PPP of 4.2 yuan per dollar, this implies China's purchasing power for some capital-intensive goods is less than the market exchange rate indicates. Compared to what the United States needs to spend on the same unit of similar equipment, in some equipment sectors China needs to spend more than the market exchange rate suggests. This has been a consistent result in all World Bank PPP price surveys of China since their inception in 2005 (table 2).

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The notion that China has a cost disadvantage in some forms of equipment and technology may seem at odds with China's ability to make cheaper manufactured products and export them across the globe. China is a global manufacturing superpower. How is it possible that China's purchasing power for some technology and equipment could be less than the purchasing power implied by the market exchange

24 The World Bank typically calls this "GDP at PPP prices." It is the broadest measure of all PPP-adjusted prices, and as such gives an indication of PPP-adjusted total economic activity.

25 The World Bank sector-level PPPs are not updated frequently; the last update was published in May 2020, based on data collected in 2017. See World Bank, *Purchasing Power Parities and the Size of World Economies: Results from the 2017 International Comparison Program*, May 2020, https://openknowledge.worldbank.org/bitstreams/d508f4dd-1075-579f-843d-cae5631a0a61/download. However, the World Bank PPP price series has important advantages compared to alternatives such as bespoke PPPs calculated from composite or estimated data. First, these PPPs are based on actual price data collected in the field, not on estimates calculated from proxy variables. Second, they provide a consistent data set, collected according to consistent criteria. So, for example, they show that since the first field survey in 2005 through the latest one in 2017, China's PPP for machinery and equipment has revealed lower purchasing power than that implied by the MER. This data is counter to the common perception in American national defense circles that PPP exchange rates will always imply greater purchasing power than the MER.

26 World Bank International Comparison Program, *Global Purchasing Power Parities Methodological Handbook*, 2005; OECD, *Methodological Manual on Purchasing Power Parities*, 2012.

27 These studies include Eaglen, *Keeping Up with the Pacing Threat*; Robertson, "International Comparisons of Real Military Purchasing Power"; Robertson, "China's Defense Budget Is Much Bigger Than It Looks"; Beaver, *Cold War Lessons for Estimating the Chinese Defense Budget*; and Bartels, *China's Defense Budget in Context*.

28 Early 2000s versions of the annual Pentagon report on Chinese military power and early 2000s versions of estimates by SIPRI and IISS initially took the approach of referencing a single economy-wide PPP.

29 "Machinery and equipment" is a broad category that includes general purpose machinery, special purpose machinery (e.g., mining and construction equipment), engines, compressors, machine tools, computers and information processing equipment, computer software used in industrial production, electrical machinery, and motor vehicles, among other goods. World Bank International Comparison Program 2011 Operational Guide, *Machinery and Equipment: Approach and Data Requirements*, https://thedocs.worldbank.org/en/doc/767971487260745488-0050022017/original/ICPOGMachineryEquipmentDraft.pdf.

Units: Chinese yuan per 1 U.S. dollar	2005	2011	2017
Market Exchange Rate	8.2	6.5	6.8
GDP Purchasing Power Parity	3.4	3.5	4.2
Equipment Purchasing Power Parity	8.8	7.7	9.3

Table 1. China Market Exchange Rates and Purchasing Power Parity Exchange Rates

Source: World Bank International Comparison Program, 2005, 2011, and 2017 surveys. https://www.worldbank.org/en/programs/icp/data#1

Units: Market Exchange Rate/Purchasing Power Parity	2005	2011	2017
GDP Purchasing Power Parity	2.4	1.9	1.6
Equipment Purchasing Power Parity	0.9	0.8	0.7

Table 2. China's Indicative "Purchasing Power" Relative to the Market Exchange Rate

Source: Calculated from Table 1.

rate? Much of China's manufacturing prowess is based on imported equipment and technologies. Many of China's manufactured exports, such as consumer electronics, are assembled from imported components that often comprise the bulk of the product's technological capability and total value.[30] Most advanced Chinese manufactured goods (such as cars) are assembled in factories using imported machine tools and robots.[31] China also depends on imported technology (e.g., advanced semiconductors) in new technology fields with military applications, such as AI.[32]

In some technology and equipment subsectors, China and other developing economies face constraints that raise the overall cost of such equipment. These include but are not limited to tariffs, non-tariff trade restrictions such as sanctions, taxes, the cost of delivery and other transaction costs (such as legal, contractual, and negotiation costs), and the cost of installation.[33] Other additional costs may include technology indigenization or assimilation, which refers to the cost of learning how to use and maintain a technology or piece of equipment as well as the cost of integrating it into an overall production process, as distinguished from the simple purchase price of the equipment.[34]

The effects of learning curves and barriers to trade are often seen with respect to advanced manufacturing equipment but may also apply to sub-component units that make up a larger system such as a vehicle or aircraft. There are other reasons why the cost of an imported technology or piece of equipment could be higher in a developing economy than in a developed economy. For example, the market for a specific technology or equipment (e.g., the newest smartphone, the flashiest sportscar, or business jet aircraft) may be smaller or less competitive in a developing economy than the market in an advanced economy, raising unit costs.

Finally, in certain higher technology sectors such as aerospace, submarine vehicles and propulsion, and

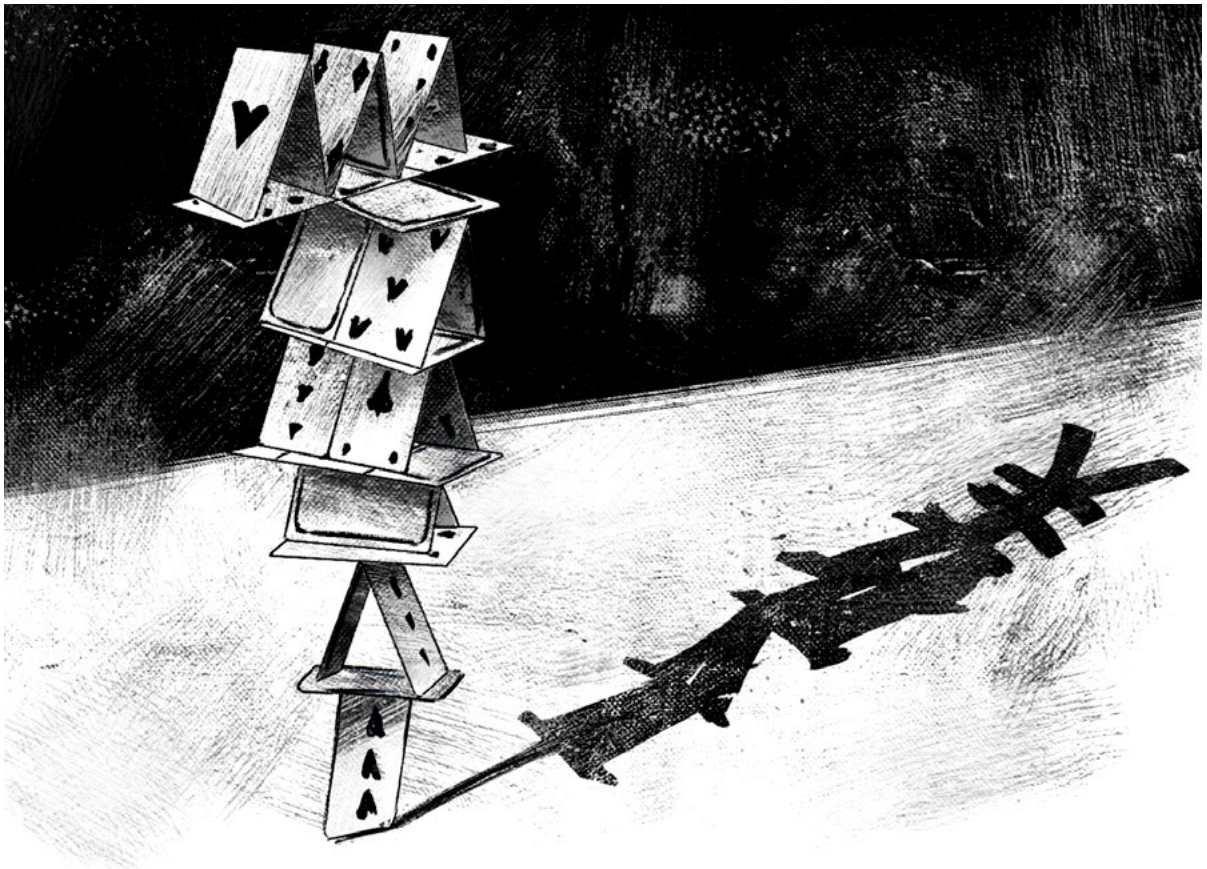
30 The Apple iPhone provides an example. Chinese labor and components account for about 3 percent of the total cost of an iPhone 15 assembled in and exported from China. Components and technologies sourced from the United States account for about 33 percent; South Korea, 29 percent; and Japan, 10 percent. See "iPhone 15 teardown reveals 10% costlier parts than 2022 flagship," *Nikkei Asia*, October 21, 2023, https://asia.nikkei.com/Business/Technology/iPhone-15-teardown-reveals-10-costlier-parts-than-2022-flagship.

31 China imports 60 to 70 percent of its industrial robots, for example. Many of the domestically produced robots are made by foreign joint ventures. The leading domestic robot producer, Etsun, has an estimated 4 percent share of the market. Cissy Zhou, "China's robotics revolution falls behind target as technology gap with rivals Japan, Germany persists," *South China Morning Post*, February 20, 2021 https://www.scmp.com/economy/global-economy/article/3122430/chinas-robotics-revolution-falls-behind-target-technology; Hongyong Zhang, "The Rise of Robots in China: Implications for Japan," Australian National University, https://ajrc.crawford.anu.edu.au/department-news/19450/rise-robots-china-implications-japan; "Why China is focused on a robotic future," Macquarie, May 11, 2022, https://www.macquarie.com/au/en/perspectives/why-china-is-focused-on-a-robotic-future.html.

32 "China's Rush to Dominate A.I. Comes With a Twist: It Depends on U.S. Technology," *New York Times*, February 21, 2024, https://www.nytimes.com/2024/02/21/technology/china-united-states-artificial-intelligence.html.

33 PPP price data surveys seek to capture these additional costs. See, for example, OECD, *Eurostat-OECD Methodological Manual on Purchasing Power Parities*, European Communities/OECD, 2006, especially 36, 76, 147. Sanctions and other barriers to technology access imposed by trade partners might also be considered a "tax," in the sense that they may increase the cost of a good.

34 中国科技统计年鉴 (China Statistical Yearbook of Science and Technology), various years. See, for example, Ministry of Science and Technology, *China Statistical Yearbook of Science and Technology 2021* (Beijing: China Statistics Press, 2021), 56–58.



AI, the total cost for a developing economy to develop and procure domestic equipment or technology with performance equivalent to existing global alternatives may be higher than the cost of competing products from advanced economies. The additional costs may include research and development, the cost of failed or abandoned programs, the cost of training and retaining skilled or specialized workers and managers for that sector, and the cost of learning to produce a new good and setting up a new manufacturing supply chain. The high cost of developing a domestic alternative (and at least initially, the lack of export markets) may limit the total number of units that can be purchased, which in turn may contribute to high per-unit costs.

Inflating the Least Lethal Capabilities the Most

The highest estimates for China's defense spending rely on PPP exchange rates, but these estimates have four problems. First, some estimates focus on wage differentials rather than on the equipment or technology that underpins modern military power. Moreover, besides a focus on labor rather than technology, the wage values employed exaggerate China's unit labor cost advantage in the defense sector.

Peter Robertson's 2019 study drew media and policy attention to China's lower relative wages as a source of defense spending advantage relative to the United States and other advanced economies.[35] After this study was published, references by U.S. military leaders, politicians, and the sponsors of the 2023 China Defense Spending Transparency Act in the Senate to China's low wages as a factor in higher estimates of Chinese defense spending also increased.[36] In his 2019 study, Robertson calculated a bespoke PPP for China's defense sector wages. He argued China's defense labor exchange rate was 1.2 yuan per dollar, or more than five times lower than the market exchange rate and almost four times lower than the general PPP exchange rate for China's GDP of 4.2.[37] A lower value for the exchange rate will imply

35 Robertson's 2019 work was widely cited and emulated. See *The Economist*, "Nominal spending figures understate China's military might"; Deal, "China could soon outgun the U.S."; Greenwalt, "China Already Outspends US Military? Discuss"; Beaver, *Cold War Lessons for Estimating the Chinese Defense Budget*; Bartels, *China's Defense Budget in Context*.

36 Stenographic Transcript Before the Committee on Armed Services; Stavridis, "China's military spending is much bigger than we thought"; Congressional Record, Proceedings and Debates of the 118th Congress First Session, S1895.

37 Note that a lower value for the exchange rate will produce a higher estimated budget figure in PPP dollar terms, because the original budget in local currency terms will be divided by a smaller number.

a larger equivalent amount spent when converting to U.S. dollars. The Robertson estimate is based on a complex methodology for deriving a defense labor exchange rate, constructed from proxies for wages as a share of GDP and further adjustments for human capital — all without reference to labor productivity.

In place of such composite estimates, choosing actual Chinese and U.S. military wage data would have produced a more accurate result. In both militaries service income is affected by rank, time in grade, cost of living at duty station, and other factors. A U.S. Army sergeant with two years or less of experience in that rank earns about $2,730 per month, while the equivalent rank in the Chinese military, a *zhongshi*, earns about 7,300 yuan per month (or about $1,014 at 2024 MER).[38] This wage data suggests a military labor PPP exchange rate of 2.7 yuan per dollar, indicating that China's advantage in military labor costs is less than half that implied by Robertson's 1.2 yuan per dollar figure.

A growing share of China's military budget comprises spending on such advanced equipment, but existing estimates of China's defense spending fail to use a sector-specific PPP for technology and equipment, leading to an inaccurate assessment of total defense spending.

Second, some studies that overestimate Chinese military spending apply PPP adjustments inconsistently. They use sector-specific PPP estimates for one type of defense spending, such as personnel costs, while applying the general GDP PPP exchange rate (which also includes wages and consumption goods) to the rest of the military budget, including to the acquisition of advanced weapons platforms and their component systems. A growing share of China's military budget comprises spending on such advanced equipment, but existing estimates of China's defense spending fail to use a sector-specific PPP for technology and equipment, leading to an inaccurate assessment of total defense spending.

A third issue in applying PPP exchange rates to defense spending relates to the definition and purpose of PPPs noted earlier. Properly applied, PPP exchange rates reveal price differences for the same or similar goods. A t-shirt in China may be the same as a t-shirt in America, but a fighter plane, a submarine, or a military servicemember may not be the same or even similar when capabilities, personnel training, operational context, and supporting systems are considered. China may have relatively lower wages for enlisted conscripts, but the effectiveness of those two-year soldiers relative to professional American enlisted personnel (who often serve for much longer periods) is questionable.[39] The same applies at the level of noncommissioned officers, where U.S. noncommissioned officers perform many tasks performed by commissioned officers in China.

Another way of viewing the same or similar goods problem for PPPs applied to military personnel would be to consider units of GDP produced per worker in the overall economy. This shows that American workers are 7.5 times more productive than Chinese workers (at MER), or 4.7 times more productive after inflating China's GDP for purchasing power.[40] American military forces differ from Chinese forces in terms of actual experience, the extent and realism of professional training, and the longer-term commitment of professionals to their military career. The higher U.S. military wages, personnel costs, and veterans' benefits

38 These are salary figures; both U.S. and Chinese numbers exclude housing and other benefits. "E-5 Basic Pay Rate—Enlisted Military Payscales," Federalpay.org, https://www.federalpay.org/military/grades/e-5; "Preferential policies for Chongqing college students to join the army in 2022 [2022年重庆大学生参军入伍优待政策], Longfengqiao Subdistrict Office of Beibei District People's Government of Chongqing, December 27, 2022, https://www.beibei.gov.cn/jz/bbqlfqjd/zwgk_55834/zcwj_jz/qtgw/202212/t20221227_11425399.html; "[Recruitment Season] 2022 University Graduate Recruitment Promotion: Enlistment is Employment - Direct Recruitment of Sergeants, Listen to What Experienced People Say" [【征兵季】2022年大学毕业生征兵宣传：入伍即就业之直招军士篇, 听听过来人怎么讲], University of Science and Technology of China, May 16, 2022, https://rwb.ustc.edu.cn/2022/0516/c7292a554494/page.htm; "2022 Military Benefits Table" [2022年当兵待遇表], Douyin, December 16, 2022, https://www.douyin.com/zhuanti/7222030681647253559.

39 Eric Danko, "Officer and Enlisted Quality Comparison in the U.S. and PLA," *Wild Blue Yonder*, May 13, 2022, https://www.airuniversity.af.edu/Wild-Blue-Yonder/Article-Display/Article/3025298/officer-and-enlisted-quality-comparison-in-the-us-and-pla/. As Danko concludes, "The enlisted and officer quality within the United States military is superior to those within the People's Liberation Army."

40 "People's Republic of China: 2019 Article IV Consultation-Press Release; Staff Report; Staff Statement and Statement by the Executive Director for China," International Monetary Fund, August 8, 2019, https://www.imf.org/en/Publications/CR/Issues/2019/08/08/Peoples-Republic-of-China-2019-Article-IV-Consultation-Press-Release-Staff-Report-Staff-48576; World Bank, "GDP Per Person Employed Constant 2017 PPP $," World Development Indicators, https://databank.worldbank.org/reports.aspx?source=2&series=SL.GDP.PCAP.EM.KD; "China Labour Productivity Growth," CEIC, https://www.ceicdata.com/en/indicator/china/labour-productivity-growth.

that attract and retain these forces likely reflect an American military advantage, not a disadvantage.[41]

Finally, the estimates that suggest China is rapidly approaching American military spending levels and implied military effectiveness turn logic on its head. They argue that China's lower wage and price levels — due to its lower level of economic and technological development — are a military advantage rather than a disadvantage. However, any hypothetical future conflict between China and the United States is more likely to be determined by the relative strength of advanced air, sea, and space capabilities on each side, not the relative number of low-wage infantry soldiers on each side. Chinese military systems meant to compete with American capabilities, such as fighter aircraft, submarines, or precision-guided weapons, will be based at least in part on globally sourced technology that is costly to acquire, or on costly indigenous development and substitution for globally sourced technologies — costs that low wages cannot offset.

None of these relative cost bases, whether MER or PPP, are static. In China's case, the PPP data show that domestic prices have tended toward convergence with global prices as China develops and further integrates with the global economy. This trend is likely to continue, both for areas where China currently has a cost advantage (such as labor), and for areas where it currently has a disadvantage (such as equipment and technology). For this reason — and because we cannot assume that domestic Chinese weapons systems or personnel are equivalent to their U.S. counterparts — there is a strong argument for using the market exchange rate to convert local currency defense budgets. Using MER is easier and less susceptible to accidental or willful distortion. But if specialized sector-level PPP exchange rates are used for factors such as labor (the approach taken in the highest estimates for China's defense spending), then specialized sector-level PPPs should be used for equipment and technology. This is the approach we take in the next section.

Chinese and American Defense Spending: Getting It Right

In this section, we outline a set of principles for comparing defense spending more accurately.[42] We begin by establishing a parallel and consistent set of budget items to compare. In the Chinese case, we include some aspects of off-budget spending (i.e., defense-related expenses not included in China's official defense budget). Some of these are typically published in Chinese government sources but are not included in the official defense budget. These include spending on paramilitary domestic security forces and military construction. We include the published budget of China's Ministry of Veterans Affairs as part of military pensions and financial support to families.[43] We also include off-budget spending that must be estimated.[44] We account for three types of off-budget spending that are not published in official Chinese government sources. First, we include China's additional payments to military families (such as health benefits and welfare payments) and military pensions. Second, we estimate Chinese research and development spending that is relevant to defense applications but not included in the official military budget. Finally, we estimate the Chinese Coast Guard budget. We use data published by China's Ministry of Finance for our estimate, and supplement this with benchmarking. Our benchmarking includes historical spending, growth trends, the long-term average ratio of certain off-budget spending to the official defense budget, and comparison to published sources, including data published by the Stockholm International Peace Research Institute.

An essential part of our method is to include similar U.S. spending categories for comparison: the Department of Defense base budget (including defense research and development), the Veterans Administration budget, and the Department of Homeland Security budget (at least those elements that have a role in national defense such as the Coast Guard). For this assessment, we have excluded the fissile material portion of both sides' nuclear weapons programs. On the U.S. side, material for and maintenance of

41 On challenges in training the PLA's enlisted soldiers, see Marcus Clay, Dennis J. Blasko, and Roderick Lee, "People Win Wars: A 2022 Reality Check on PLA Enlisted Force and Related Matters," *War on the Rocks*, August 12, 2022, https://warontherocks.com/2022/08/people-win-wars-a-2022-reality-check-on-pla-enlisted-force-and-related-matters/. Also, see Danko, "Officer and Enlisted Quality Comparison in the U.S. and PLA."

42 Many of these methods were first outlined in George J. Gilboy and Eric Heginbotham, *Chinese and Indian Strategic Behavior: Growing Power and Alarm* (Cambridge: Cambridge University Press, 2012).

43 The Ministry of Veterans Affairs provides centralized management of veterans support, including advocacy for improved pensions, policies to support veterans such as tax breaks and access to subsidies, and post-separation job placement. The Ministry of Veterans Affairs also provides financial support, such as death and disability benefits, to retired veterans, and a living allowance for demobilization of veterans in townships and rural areas. See Kenneth Allen and Marcus Clay, "All Eyes on the Ministry of Veteran's Affairs," *China Brief* 22, issue 5, Jamestown Foundation, May 11, 2022, https://jamestown.org/program/all-eyes-on-the-ministry-of-veterans-affairs/.

44 An amount for military pensions is included in the PLA official budget. However, a portion of military pensions and benefits are also paid by the Ministry of Civil Affairs. Additional financial support to veterans appears in the Ministry of Finance budget. See Nan and Fei, *A New Estimate of China's Military Expenditure*. Estimating China's off-budget spending is becoming more difficult as Beijing has placed even greater restrictions on previously published economic and financial data.

warheads are largely funded through the Department of Energy.[45] The United States has far more nuclear warheads than does China — roughly 5,550 warheads (including 1,750 retired ones) versus a current estimate of about 500 for China (growing to about 1,000 by 2030).[46] Therefore, our exclusion of nuclear weapons programs is conservative in the sense that it eliminates a category where the United States likely spends more than China. We also exclude intelligence programs and space programs that fall outside military purview and budgets.[47] Budgets in these areas are classified, making them difficult to estimate, and resulting capabilities have a number of important non-military functions in addition to their military ones.

We estimate that China's 2024 defense spending, including off-budget items and appropriately adjusted for PPP, is equivalent to $471 billion.

Second, we apply balanced and more accurate PPP exchange rate conversions to each relevant subcategory of Chinese defense spending: personnel, operations and training, and equipment. For personnel costs, we create a "personnel PPP" that includes both wages and consumables such as clothing and food, which determines non-salary compensation. For the personnel PPP, we use available data on military salaries and the World Bank–published PPP for individual consumption, weighted equally, to develop a PPP exchange rate for this category. We create an "operations and training PPP" that reflects a combination of military expenses including some items, like fuel, with global prices at market exchange rates; military consumables like ammunition (at a general economy-wide PPP); and items such as maintenance and repairs, temporary shelter, and general consumables (at a consumption PPP). These three components are weighted equally in the operations and training PPP. Finally, we create a "military equipment PPP." Military equipment and weapons systems engage the most advanced sectors of the economy. The most capital-intensive systems comprise the largest part of the equipment budget. We use the World Bank's published equipment PPP exchange rate to estimate the relative purchasing power for the equipment portion of China's official defense budget.[48] All calculations are available in the online appendix.[49]

We estimate that China's 2024 defense spending, including off-budget items and appropriately adjusted for PPP, is equivalent to $471 billion (table 3). This is higher than the spending level implied by recent estimates from careful and credible sources such as the Stockholm International Peace Research Institute and the International Institute for Strategic Studies, but it is far below estimates claiming that China's defense spending is nearly $700 billion — or 85 percent of the 2024 U.S. Department of Defense budget. Moreover, when similar categories of spending are included, U.S. defense-related expenditures total between $1,229 billion and $1,319 billion (table 4).[50] Based on these figures, China's defense spending is 36 to 38 percent as large as that of the United States when similar spending categories are included for both sides.[51]

Notably, the U.S. Department of Defense budget is

45 In fiscal year 2024, the U.S. federal budget amount allocated to "Other National Defense" is about $47 billion. See "National Defense Budget Estimates for FY 2024," Office of the Undersecretary of Defense (Comptroller), May 2023 (this source is commonly known as the "Green Book"), https://comptroller.defense.gov/Portals/45/Documents/defbudget/FY2024/FY24_Green_Book.pdf. The majority of this allocation ($35 billion) is for Department of Energy defense-related activities such as researching and sustaining nuclear warheads and dealing with legacy nuclear weapons program waste sites. For an explanation of these activities, see U.S. Department of Energy, "Department of Energy FY 2025 Budget in Brief," March 11, 2024, https://www.energy.gov/sites/default/files/2024-03/doe-fy-2025-budget-in-brief-v2.pdf.

46 Hans Kristensen et al., "Status of World Nuclear Forces," Federation of American Scientists, March 31, 2023, https://fas.org/issues/nuclear-weapons/status-world-nuclear-forces/; U.S. Department of Defense, *Military and Security Developments Involving the People's Republic of China 2023: Annual Report to Congress*, https://media.defense.gov/2023/Oct/19/2003323409/-1/-1/1/2023-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA.PDF.

47 Note that some parts of these programs (e.g., procurement of nuclear missile bodies and maintenance of the force structure) almost certainly fall within the base military budgets of both countries, and we make no attempt to exclude those portions.

48 There is an argument for using the market exchange rate for the equipment budget, or instead trying to break the equipment budget into less capital-intensive and more capital-intensive components, each using a different appropriate PPP exchange rate. However, the World Bank equipment PPP has advantages as well: It is based on actual price data collected in the field, and may better reflect the cost China faces in closing the gap with advanced Western weapons systems.

49 The appendix is available here: https://ssp.mit.edu/publications/2024/china-defense-spending-estimate-method.

50 The range depends on what counts as the functional equivalent of China's Coast Guard and the People's Armed Police: the entire U.S. Department of Homeland Security budget, or only the U.S. Coast Guard budget.

51 Estimates for U.S. fiscal year 2024 defense spending are based on the following sources: for Department of Defense discretionary budget, see "Department of Defense Appropriations Act 2024"; for Department of Defense mandatory budget, see "National Defense Budget Estimates for FY 2024," May 2023; "Department of Veteran's Affairs FY 2025 President's Budget Request," U.S. Department of Veteran's Affairs, March 11, 2024, https://www.va.gov/opa/docs/remediation-required/management/fy2025-va-budget-rollout-briefing.pdf; "Fiscal Year 2025 Congressional Justification," Department of Homeland Security, March 11, 2024, https://www.dhs.gov/sites/default/files/2024-04/2024_0311_department_of_homeland_security_overview.pdf.

	Billion yuan	Billion U.S. dollars, Market Exchange Rate	Billion U.S. dollars, Purchasing Power Parity-adjusted
Official defense budget	1,670.0	232.0	321.0
People's Armed Police	183.7	25.5	30.9
Coast Guard	19.3	2.7	3.2
Defense construction	5.2	0.7	2.2
Military pensions and family support	267.2	37.1	79.2
Additional defense R&D	250.5	34.8	34.8
Total	**2,396**	**333**	**471**

Table 3. China's Estimated 2024 Defense Spending

Nuclear weapons, space, and intelligence programs not included

	Billion U.S. dollars
Total Department of Defense	846
Of which: Department of Defense (discretionary)	825
Of which: Department of Defense (mandatory)	21
Department of Veterans Affairs	369
Department of Homeland Security	104
Of which: Coast Guard	14
Total Department of Defense, Veterans Affairs, Coast Guard only	**1,229**
Total Department of Defense, Veterans Affairs, Department of Homeland Security	**1,319**

Table 4. United States 2024 Comparable Defense Spending

Nuclear weapons, space, and intelligence programs not included

somewhat larger than what is indicated in most public policy and media discourse. For example, most coverage of the U.S. defense budget focuses only on the discretionary budget proposed by the administration subject to Congressional approval. In March 2024, this budget of $825 billion was approved by Congress and signed by the president.[52] However, the Defense Department also has a material budget composed of mandatory spending items that are required by law (this is largely retirement pay). For fiscal year 2024, this mandatory budget is estimated to be just over $21 billion.[53]

Off-budget items not included in China's official 2024 defense budget account for about 30 percent of China's total defense spending. Similar off-budget items accounted for 31 percent to 36 percent of total U.S. defense spending in the same year, depending on what portions of the Department of Homeland Security budget are included.

Our assessment contains assumptions, simplifications, and uncertainties. For clarity and brevity, we show only a single estimate here. However, our method could be used to produce a high-low range for total Chinese defense spending, based on reasonable variations on assumptions including some uncertainty about Chinese data. There are different ways that one might compare American and Chinese defense spending. Including or excluding different categories of spending might provide a better sense

52 "Congress Passes $825 Billion Defense Spending Bill," *Real Clear Defense*, March 25, 2024, https://www.realcleardefense.com/2024/03/25/congress_passes_825_billion_defense_spending_bill_1020555.html; "Congress passes $825 billion defense spending bill amid political battles, government shutdown threat," *Breaking Defense*, March 23, 2024, https://breakingdefense.com/2024/03/congress-passes-825-million-defense-spending-bill-amid-political-battles-government-shutdown-threat/.

53 "National Defense Budget Estimates for FY 2024."

of how spending compares in different contexts.[54] However, no reasonable method of estimating overall expenditure would indicate that China is on the cusp of closing the gap in defense spending with the United States.

Conclusion

Recent estimates that claim that China's defense spending will soon overtake that of the United States commit two methodological errors. First, they add off-budget items to China's official defense budget without adding such categories to the American side of the ledger. Second, they apply inappropriate and exaggerated PPP exchange rates to inflate the value of spending on China's side of the ledger. The appropriate PPP adjustments we have outlined help to formulate a more accurate "military PPP," showing that China's defense purchasing power is currently about 1.4 times greater than that implied by market exchange rates. This is well below the widely cited estimate of more than double the purchasing power of market exchange rates.[55]

Estimates that rely on a PPP adjustment are likely to become less relevant over time. As China continues to develop and integrate with the world economy, its overall price levels have been converging with global prices. This is indicated by the declining difference between the market exchange rate and the overall PPP exchange rate for GDP (tables 1 and 2).[56] China's ambition to create a more technologically advanced "world-class force" on par with the U.S. military will lead it toward greater emphasis on procuring capital- and technology-intensive equipment and away from the spending areas most advantaged by PPP differences, such as personnel-intensive forces.[57]

Washington must allocate scarce resources, and unbalanced assessments of China's defense spending could undermine the ability of planners and policymakers to properly balance their efforts.

Observation and assessment of actual material capabilities is a complement to budget analysis. Simply counting weapons and platforms provides a check on some of the more alarming recent estimates of Chinese defense spending. China has fewer fourth- and fifth-generation aircraft, fewer nuclear submarines, fewer aircraft carriers, and lower naval tonnage (despite rapid construction of new ships) than would be expected if it were spending nearly $700 billion per year on defense.[58] China continues to import key equipment and technologies such as aircraft engines, submarine and naval ship propulsion systems, radars, and advanced microprocessors.[59] It also exports fewer military systems — and especially fewer high-tech components and subcomponents — than would be expected if it could produce military goods at the same

54 During the Cold War, the CIA prepared three different estimates of Soviet spending, depending on whether the assessment concerned, for example, the Soviet ability to fight foreign wars or, rather, its ability to exercise domestic control. James E. Steiner and Franklyn D. Holzman, "CIA Estimates of Soviet Military Spending," *International Security* 14, no. 4 (Spring 1990): 185–98.

55 Robertson, "International Comparisons of Real Military Purchasing Power." Robertson made revisions to his assumptions in 2022 and then again in 2023, bringing his conclusions more in line with mainstream analyses from sources such as SIPRI and IISS. These recent downward revisions have not received the attention his 2019 papers received. Peter Robertson, "The Real Military Balance: International Comparisons of Defense Spending," *The Review of Income and Wealth* 68, issue 3 (September 2022): 797–818; Robertson, "China's Defense Budget Is Much Bigger Than It Looks."

56 In 2005, China's economy-wide PPP implied nearly 2.5 times the purchasing power of the MER, but as of 2017 it represented only 1.6 times the purchasing power of the MER. "International-comparison-program-(icp)-2005," World Development Indicators, https://databank.worldbank.org/source/international-comparison-program-(icp)-2005; "International Comparison Program," World Bank, https://databank.worldbank.org/source/icp-2017. While overall prices will tend to converge as China's economy continues to develop, it is possible for certain subsectors to show a different trend. This has been the case for equipment, for example, between 2005 and 2017. This may be a result of China increasing its spending on ever more complex and costly technology and equipment during this period. Over time, however, it is likely that even the equipment sector will tend to converge with global prices. That sectoral trend could be interrupted or reversed if China decouples from certain global markets.

57 M. Taylor Fravel, "China's 'World-Class Military' Ambitions: Origins and Implications," *The Washington Quarterly* 43, no. 1 (2020): 85–99.

58 The U.S. Air Force, Navy, and Marine Corps operate more than twice as many modern (fourth- and fifth- generation) aircraft as do the PLA Air Force and Navy, with a much larger relative gap in the fifth-generation category. The U.S. Navy operates eleven large nuclear-powered aircraft carriers, supplemented by nine landing helicopter assault and landing helicopter dock ships that are capable of launching fixed-wing aircraft. For its part, China operates two medium-sized conventionally powered aircraft carriers, and another has been launched but is not yet operational. Although China has built more small warships than the United States, total U.S. naval tonnage is more than twice that of China, even when Chinese ships that have not yet been commissioned are included. The U.S. fleet includes roughly two and a half times as many vertical launch cells (a metric of missile firepower) as China's. Both countries operate fifty-three attack submarines, but all of the U.S. boats are nuclear-powered, while all but six of China's boats are diesel-powered (and comprise roughly one-third the tonnage of U.S. attack boats). IISS, *The Military Balance* 2022, February 2022.

59 SIPRI Arms Transfers Database, https://www.sipri.org/databases/armstransfers.

quality but lower prices than others.[60] This material gap provides evidence that is inconsistent with the claim that China is already spending nearly as much as the United States is on defense.

Providing a more accurate assessment of Chinese defense spending does not imply that the United States can relax or dismiss the threat China now poses to American power and influence. Budgets constitute inputs, rather than outputs. The capabilities they finance should be considered in conjunction with the missions, timelines, and geography in which those capabilities are applied. Indeed, as others have observed in the political context, China can pose problems without catching up.[61]

Accurate defense spending assessments are important for many reasons. First, they are essential for more effective American security preparedness and responses. Claims that China spends nearly as much on defense as the United States distract from the equally important debate about how the United States allocates resources to most effectively maintain or even improve U.S. military advantages relative to China. Two examples have been highlighted by the war in Ukraine: spending on big-ticket items such as major aircraft and naval ship programs — sometimes justified on the basis of increasing Chinese capabilities[62] — should be reviewed in the context of the effectiveness of much cheaper uncrewed air and sea vehicles such as Mavics and Magura V5s, and the requirement for sufficient investment in munitions and munitions manufacturing capability, such as air defense missiles and 155mm artillery shells.

In a related example, there is currently a policy debate about whether the United States should retire older combat aircraft and recapitalize its aging airpower inventory.[63] Central to this debate are estimates of current Chinese and U.S. capabilities, as well as expected spending and procurement trends. The next few years might be the moment of maximum volatility, as one recent commentary suggests.[64] Those who argue against retiring older aircraft assert that the threat is imminent and that the magnitude of the current threat means that the United States cannot afford to do without the service of even older aircraft. Those who look to rejuvenate the force, on the other hand, argue that the U.S. military can and should accept some modest risk now in order to maximize capability in the longer term, when the challenges may become larger. Maintaining old aircraft in the inventory burdens the force with costs and inefficiencies that retard its capabilities in the longer term. Correctly understanding defense spending economics should inform this and other decisions.

Second, the United States faces multiple global security challenges. Foremost among these is the ongoing war in Ukraine caused by Russia's full-scale invasion in February 2022. Europe remains a core American security and economic interest. Washington must allocate scarce resources, and unbalanced assessments of China's defense spending could undermine the ability of planners and policymakers to properly balance their efforts. At the same time, while the United States must deter and if necessary meet any Chinese military challenge, Washington still has an interest in mitigating security competition and security dilemmas in the Indo-Pacific region — at a minimum, to help maintain existing alliances and partnerships. Overestimating China's military spending could encourage American overreactions that might undermine its own interests in the Indo-Pacific. Alternatively, overestimating China's military spending might encourage an opposite and equally unwelcome American response — an impulse to abandon interests in Asia that it might otherwise defend if the balance of power appeared less dire.

Finally, accurate assessments are also important for deterrence. Both sides should have an accurate assessment of the balance of material power — inaccurate assessments could lead either side to take unnecessary risks or to make fateful misjudgments. In other words, it is foolish to encourage hotheads in China by telling them that China's defense spending is nearly equivalent to U.S. spending. It is not. Large gaps in spending, power, and capability remain, and it is better for policymakers in both the United States and China to know it.

60 Many factors impact weapons sales, including domestic politics and foreign policy priorities. Nevertheless, a diverse array of states export more military systems than China, especially high-tech ones. France, with military manpower 12 percent that of China, exported more warships by value—and three times more naval weapons, sensors, and engines—than China between 2016 and 2022. SIPRI Military Expenditures Database, https://www.sipri.org/databases/armstransfers.

61 Thomas J. Christensen, "Posing Problems without Catching up: China's Rise and Challenges for U.S. Security Policy," *International Security* 25, no. 4 (Spring 2001): 5–40, https://www.jstor.org/stable/3092132.

62 Eric Lipton, "Faced with Evolving Threats, U.S. Navy Struggles to Change," *New York Times*, September 2, 2023, https://www.nytimes.com/2023/09/04/us/politics/us-navy-ships.html.

63 Audrey Decker, "USAF: Let's cut older aircraft to fund newer weapons," *Defense One*, March 11, 2024, https://www.defenseone.com/policy/2024/03/usaf-lets-cut-older-aircraft-fund-newer-weapons/394837/?oref=defense_one_breaking_nl&utm_source=Sailthru&utm_medium=e-mail&utm_campaign=Defense%20One%20Breaking%20News:%20March%2011%2C%202024&utm_term=newsletter_d1_alert.

64 Philip Zelikow, "Confronting Another Axis? History, Humility, and Wishful Thinking," *Texas National Security Review* 7, no. 3 (Summer 2024), https://tnsr.org/2024/05/confronting-another-axis-history-humility-and-wishful-thinking/.

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***Addendum:** Shortly after the* Texas National Security Review *published this essay, the World Bank published new PPP data collected in 2021 (https://www.worldbank.org/en/programs/icp/data). Using the new PPP data and our method would result in estimated 2024 Chinese defense spending equivalent to $474 billion, slightly more than the original $471 billion estimate in this essay. Notably, compared to the older data set, the new PPP data indicate a modest erosion of China's relative purchasing power for some inputs necessary for a higher-tech military force such machinery, equipment, and education. The online appendix to this essay will be updated with the new data.*

Online appendix: *See the online appendix at https://ssp.mit.edu/publications/2024/china-defense-spending-estimate-method.*

Image: *Dennis Sylvester Hurd*[65]

65 For the image, see https://www.flickr.com/photos/dennissylvesterhurd/29888238994.