Dynamic Balances: American Power in the Age of Innovation

Teryn Norris
Neil K. Shenai

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Present-day popular narratives about geopolitics fixate on the notion that rising great powers present an existential threat to the U.S.-led world order. The economic rise of the People's Republic of China has exacerbated the United States' anxiety regarding relative power decline, especially in the wake of the recent global financial crisis, wherein China's model of authoritarian capitalism seems to have weathered the economic storm far better than the United States. Contrary to popular conceptions, this essay argues that the long-term economic advantage of leading states—reflected in their ability to generate innovation via technological progress—tilts towards the United States, even if it faces many near-term problems. This paper makes this case by exploring the political economy of innovation policies in both the People's Republic of China and the United States with regards to "green" technology, rigorously investigating the microinstitutional, macroeconomic, and cultural determinants of innovation.

Introduction

Over the past twenty years, the global consensus around America's international position has swung like a pendulum between two extremes. Some scholars, such as Dr. Francis Fukuyama, identified the end of the Soviet Union as the "End of History," or the triumph of western-style liberal democracy over all other systems of social organization.[1] Others, such as Charles Krauthammer, claimed that the world was at a "unipolar moment," led by unmatched American military hegemony, or dominance of the international system.[2]

Today, pessimism is in vogue. Commentators rightly see that the last decade has not been kind to America. American relative power has eroded through its global war on terror, costly invasions and occupations of Iraq and Afghanistan, and the emergence of rising great powers such as the People's Republic of China and India. And, of course, the United States still struggles with the lingering effects of the global financial crisis, including hundreds of billions of dollars of lost output and near double-digit headline unemployment. Public sentiment confirms this dour mood: 58 percent of respondents in a March 2010 Xavier University poll claimed that America

Teryn Norris is a leading young policy strategist and serves as president and founder of Americans for Energy Leadership. He studies public policy at Stanford University.

Neil K. Shenai is a PhD Candidate at the Johns Hopkins University School of Advanced International Studies (SAIS) studying the political economy of financial crises.

was in decline, with respondents skeptical of the long-run viability of the "American dream."[3]

In part, these extreme shifts in opinion reflect the reactive nature of public opinion. The truth lies somewhere in between. Indeed, the United States remains the only state in the international system with a truly global reach; its ability to project force in any theater is unmatched by any potential rival. That said, other states such as China, Brazil, and India have made massive strides in the last decade, experiencing robust economic growth and rising hard military power with an increasingly global footprint.

While Brazil and India's growth has been noteworthy, China's rise has stood out from the rest. Over the past thirty years, China has transformed itself from an economically prostate agriculture economy to a global economic juggernaut, having recently surpassed Japan as the world's second largest economy after the United States.[4] Moreover, China seems to have weathered the global financial crisis far better than the United States, with resilient GDP growth rates from 2007-2010 and limited financial stress in their domestic banking system.[5]

Practitioners and academics alike have tried to understand the significance of this economic shift from west to east. Various scholars have posited that China's rise marks the beginning of a new ideological struggle between so-called authoritarian great powers and liberal democracies, wherein developing countries weigh the appeal of authoritarian capitalism, with its promise of strong state capacity and efficient policymaking, against the often slow and complex political process of democratic systems. Azar Gat summarizes this ideological struggle by arguing that authoritarian capitalist states present "viable alternative path[s] to modernity," thereby threatening the ideological hegemony of western-style liberal democracy.[6] Taken together and projected forward, these trends indicate that China could be on course to overtake the U.S. economy by 2040 or sooner, depending on relative growth rates.[7]

This paper argues that contrary to popular perception, the long-term economic advantage of leading states in the international system—that is, their ability to generate technological progress via innovation—tilts towards the United States, and that calls of U.S. decline due to economic stagnation do not square with the empirical reality described below.

This paper adds some much-needed theoretical structure to this cacophonous debate. Starting from structural realist theories of international relations, this paper explores the link between economic growth and relative power position in the international system.[8] After contending that economic size allows states in the international system a greater set of political resources, this section concludes with a summary of neoclassical approaches

to growth accounting in advanced economies from economics, arguing that technological innovation is the key metric to sustaining economic growth over the long term. By establishing this theoretical foundation, this section sets the framework from which the rest of the paper proceeds. In light of the primacy of technological innovation to sustaining long-run economic growth, this paper describes recent research on the innovative capacity of both China and the United States. It does so through generic metrics of research and development funding, as well as through a targeted case study on China's and the United States' clean technology innovation capacity in an attempt to shed light on the broader innovation capacities of both states. Finally, the paper concludes with several policy recommendations for the United States, while urging the reader to maintain a healthy skepticism towards great power political projections over time. In short, this paper argues that contrary to popular perception, the long-term economic advantage of leading states in the international system—that is, their ability to generate technological progress via innovation—tilts towards the United States, and that calls of U.S. decline due to economic stagnation do not square with the empirical reality described below.

International Relations Theory: Economic Growth and Relative Power Competition

Given this paper's focus on the implications of China's economic development on the relative power dynamics between China and the United States, it is important to articulate the primacy of economic capability on structural realist interpretations of great power competitive dynamics.

According to structural realists, the single determinant of outcomes in the international system is power. Derivative of the interstate anarchy inherent to the international system, self-help is the only guaranteed means of survival. And since states' influence depends on their ability to effect change in the international system, states seek to build their capability through amassing power. Because of this, theorists such as Hans Morgenthau characterize international politics as a zero-sum struggle for power, with states controlled by agents whose interests prioritize power maximization over all other goals.[9] Power, while important, also takes many forms. Hard power can be seen as the geographic size of a state, for instance, as well as its number of military personnel. The biggest influence on a state's hard power, however, is its own economic capability. Charles Doran describes this relationship as follows:

> In terms of both additional growth in overall [state] capability and actualizing . . . military potential, greater economic size enables a country to accomplish more . . . [And] purely military variables would fail to reflect the extent to which a state had over-actualized its latent [power] base and hence would not be able to sustain that power in the long run.[10]

In other words, as Doran also shows empirically, economic power, both in terms of size (GDP) and wealth (GDP per capita), establishes the long-term

capability of a state to sustain its static hard military advantages over time. From this context, economic growth enables states to build on their capabilities for hard power accumulation. John Gerard Ruggie summarizes this point by claiming that the most comprehensive view of the international system includes both political and economic components, asserting that the evolution of the international system is at least "co-determined" by the economic activities of the political actors in question.[11]

The challenge for theorists, then, is to operationalize the link between economic growth and relative power competition in the international system. This paper describes two neorealist theories that attempt to do so, showing that changing economic growth rates have implications on relative power position in the international system. In *War and Change in World Politics*, Robert Gilpin develops his dyadic view of international relations, hegemonic stability theory, which posits that patterns of hegemony and rising challengers have perpetuated the twenty-five hundred year history of the international system. To Gilpin, singularly dominant, hegemonic states rule the interstate system through a combination of coercion and consent, fashioning international order according to their own preferences. This order provides the rules of interaction in the international system. Furthermore, the hegemonic state provides global public goods like maintenance of sea lanes and providing the global reserve currency.

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Changes in world order occur via the hegemonic challenge of rising states to the dominant state in the international system. Gilpin believed that because of the law of diminishing returns, hegemonic states' growth rates would slow over time. The late mover advantage allowed the challenger state to grow more rapidly than the hegemon, thereby allowing the challenger state to deepen its relative latent capability. As such, changes in relative position in the international system depended on these differential rates of economic growth. War is most likely when the challenger state believes the benefits of challenging the pre-existing order might exceed its costs.[12] This is Gilpin's link between economic growth and war causation in the international system. He summarizes this association below:

> A growing economy could afford the best military techniques and stay ahead of its rivals with lower rates of economic growth. Henceforth, the relative rates of economic growth among societies, the sizes of the economic bases of the societies, and the proportions of total outputs devoted to defense would increasingly determine the power and position of states in the international system.[13]

Considering Gilpin's theory today, it is clear that rising Chinese power could change China's incentives to challenge the U.S.-led world order. Granted,

Gilpin's theory ignores the agency of state leaders and aspects of nuclear deterrence, but hegemonic stability theory still motivates a capabilities-based appraisal of great power position. The centrality of economic growth to state relative power position helps emphasize the importance of long-term growth prospects in determining the trajectory of relative state power in the international system.

Doran's power cycle perspective, developed prior to Gilpin's dyadic view, rejects the purely dyadic notion of power relations. Doran asserts, for example, that China must take into account Russia's second-strike nuclear capability as well as that of the United States, India's boots on the ground as well as America's, Japan's submarines as well as those coming from further away. The power of each major state must be calculated relative to the power of all of the other major states. China should not aspire to hegemony. No state has ever dominated the central system historically, according to Doran. Instead, a dynamic equilibrium exists among all of these states inside Asia and outside. The competition for power in the system, which is tied to differing rates of absolute growth, shapes and ultimately bounds relative power growth.

Doran argues that each state follows a cycle of relative power over long time periods. Lagging somewhat, the state's foreign policy role traces a similar cycle. In contrast to a monolithic interpretation of prestige, foreign policy role consists of a state's leadership, its ability to attract allies, its functional responsibilities, its diplomatic success, and its place in economic organizations. The role a state plays is of crucial interest to the state and its competitors. Conflict, according to Doran, is most likely when the trajectory of a state's relative power cycle abruptly and unexpectedly shifts from acceleration to deceleration (or vice-versa), resulting in the sudden recognition of power-role gaps, immense strategic uncertainty, and massive inversions of force expectation. Empirical and historical evidence shows that systems transformations, which occur when many of the leading states experience such abrupt "critical" change on their power cycles in roughly the same interval, have precipitated most major wars.[14]

Both Gilpin and Doran see changing relative hard power balances as a principal cause of international conflict and systemic change. Furthermore, they both see economic growth as an enabling variable with a high cross-elasticity for military power accumulation. Per China's rise, Gilpin and Doran, albeit very differently, view changing relative power as an intervening variable that determines war causation. Given the proximate impact of economic growth on hard power capability, this paper now turns to exploring a growth model from neoclassical economic theory to better understand the changing relative power balances between the People's Republic of China and the United States. Given this theoretical exposition, the principal question remains: what does the empirical reality of each state's political economy tell us about the long-run power dynamics between the United States and the People's Republic of China?

Economic growth: In Search of Solow

Since Adam Smith, economists have tried to explain why some states experience economic growth while others do not. Yet it was only after the so-called marginalist revolution during the 1870s that economists attempted to formulate a systematic view of economic growth using theoretically robust models, stemming from the conception of "homoeconomicus," or the utility-maximizing, self-interested agent. Growth theory began to transfix the economic establishment especially during post-colonial great power struggles for global influence. The economic development of states at the periphery of the international system had reverberating effects on great power balances, particularly during the Cold War.[15]

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Against this intellectual backdrop, modern growth theory emerged. The biggest influence on this cannon was Robert Solow, an economist at the Massachusetts Institute of Technology. Starting with the then-popular Harrod-Domar model of economic growth, Solow accepted the conventional precepts that capital accumulation and investment produced economic growth. However, to Solow, the Harrod-Domar model's overly-simplistic conclusion that capital to labor ratios and constant returns to capital accumulation would produce economic growth ignored the empirical reality that economies with higher levels of income would eventually witness slowing growth rates. In other words, economic growth would hit its natural speed limit as income rose. Once an economy hit its "steady state," economic growth would cease. This steady state depended on a country's population growth rate and saving rates.[16]

Despite these rigorous assumptions, Solow nonetheless observed that economies did indeed grow. He attributed this to technological progress, or the "Solow residual." Solow had theories as to the source of technological progress, or increases in total factor productivity, but this domain lay outside of his model of economic growth. As a result, Solow's model came to be known as the "exogenous growth model," since the long-run sources of economic growth could not be explained within the model.[17]

Nonetheless, Solow provides a useful starting point in analyzing and justifying China's near double-digit growth rates, especially in comparison to the advanced industrialized world. States with low pre-existing capital stocks, such as China during the early 1980s, will experience higher levels of per-capita income growth than advanced economies that are closer to their "steady state" level of per-capita income, such as the United States. Returns to capital accumulation are higher in economies that lack large pre-existing levels of capital per worker. Thus, on a pure growth basis, the alarm over China's high growth rates relative to the United States can be understood within the Solow framework, wherein China's relative immaturity is the key source of its higher levels of income growth compared to the United States.

Furthermore, Solow provided a useful starting point for exploring the sources of economic growth. His analysis gave practitioners a yardstick to measure economic growth potential. That said, subsequent literature in both economics and political economy attempted to explain for the sources of technological progress. These are briefly summarized below.

Endogenous growth theory, popularized by Dr. Paul Romer, argues that economic growth is the natural byproduct of a given economic system. Whereas for Solow, economic growth came from external sources, Romer argues that by relaxing certain assumptions of Romer's model, namely that of perfect competition, economists could construct a model wherein monopolist rents via patents created incentives for firms to take risks and innovate. Romer observed that empirically, individuals with a lot of human capital tended to cluster together.[18] This talent gravitation created clustering of human talent, thus generating positive spillover effects, thereby nullifying the assumption of diminishing returns of accumulation. Instead of technological progress being a stochastic process, Romer argued that deliberate behavior of economic agents could produce technological progress.

This determinism has shaped the debate over state-led innovation policies, described below. And this also created the space for government intervention in fostering economic growth via enforcement of patent rights, provision of infrastructure for clustering of human talent, as well as through the direct training and funding of key innovative personnel in the economy. The latter point can take many forms, but includes provision of primary, secondary, and tertiary education, a favorable micro-level incentive structure, among other issues. These comprise a bulk of the policy implications presented below.[19]

In addition to institutions-based analysis of innovation, other scholars claimed that economic culture determined the innovation capacity of different economies. Although deemed anathema to neoclassical models of economic growth, economists had to reconcile institutional arrangements that should have created economic growth with the reality of economic stagnation in less developed countries. Societies with a strong sense of internal cohesion, atomism, and rules-based legal systems could foster economic growth. Naturally, there are cultural determinants of these phenomena, yet because cultural interpretations often devolved into normative statements about the intrinsic worth of customs, social scientists were loathe to wholesale adopt these methods. Yet sociologists still saw economic outcomes as social byproducts. Cultural determinants like leadership, trust, risk tolerance, and the norm of economic dynamism could lead to innovation, and thus, economic growth as well.[20]

Taken together, we can argue that long-term economic growth comes from several sources: capital accumulation, institutional strength via private property and a patent regime ensuring intellectual property rights of potential innovators with a robust financial system to bankroll risk taking of entrepreneurs, clustering of human talent, and a culture of entrepreneurship and innovation. Furthermore, economic growth proceeds along a continuum of rote capital accumulation followed by convergence with other advanced industrial states. Thereafter, states must innovate in order to sus-

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tain high per-capita income growth rates. This is Solow's conclusion and helps frame the economic rise of China today.

Given this grounding, this paper now turns to understanding the competitive dynamic between the United States and the People's Republic of China in order to project potential great power capabilities over time. In particular, the next section drills down to explain the political economy of innovation in both China and the United States to better inform a view of each country's long-run material capabilities.

Benchmarking National Innovation Capacity

Any state's capacity for technological innovation depends on a number of complex factors, including their macroeconomic environment, individual and firm-level microeconomic incentives, and institutional and cultural predispositions. Many of these factors, such as culture, are difficult to measure and lie beyond the scope of this article. This paper uses three measures of national innovation capacity: research and development (R&D), science and engineering education, and technology scaling.

R&D is measured by the total and relative expenditure of each state on dedicated research and development. Science and engineering education is measured by numbers of graduates from institutions of higher education. And technology scaling refers to conditions that help diffuse new technologies throughout the marketplace and establish knowledge-intensive industries, ranging from enabling infrastructure and market creation to intellectual property and the ease of doing business. Along with R&D and education, this a key measure of innovation capacity, since realizing the productivity gains of new technologies requires their diffusion throughout the economy.

In short, by these three metrics, China is improving its national innovation system but still lags significantly behind the United States. In terms of R&D, total U.S. investment as a percentage of GDP has remained relatively constant since the mid-1980s, hovering around 2.7 percent, with the federal share of total R&D consistently declining. The National Science Foundation (NSF), which publishes one of the most comprehensive reports on international innovation capacity, recently found that China's investments in

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R&D grew by over 20 percent annually between 1996 and 2007, compared to less than 6 percent annual growth in the United States. These high growth rates ignore the low starting point of China's R&D expenditures; China's R&D intensity in 2007 was still 1.5 percent, just over half the U.S. level. Moreover, this measure ignores the large difference in total GDP between the countries as well. By total expenditure, the United States dwarfs China by an approximate ratio of fifteen to one.[21]

In terms of education and workforce in science and engineering, China is rapidly developing its capacity. Whereas the United States experienced moderate annual growth in researchers of about 3 percent between 1995 and 2006, China averaged nearly 9 percent annual growth over this period. The NSF report found that the total number of Chinese researchers nearly tripled, from just over half a million to more than 1.4 million, on par with the U.S. total of around 1.4 million. This measure ignores quality differences between U.S.—educated scholar researchers and their Chinese counterparts, but serves as a useful starting point in showing that in terms of sheer manpower, China is approaching the United States.

The American higher education system maintains its strengths—especially the U.S. research university system, which performs 56 percent of U.S. basic research and continues to attract the world's top students and faculty—but its position continues to decline in terms of science and engineering graduates. According to the same NSF report, U.S. students earned only 11 percent of the world's four million science and engineering first university degrees (equivalent to an undergraduate degree) awarded in 2006, compared to 21 percent in China. Science and engineering degrees are only about one-third of U.S. bachelor's degrees, compared to 53 percent in China. Only about 5 percent of U.S. bachelor's degrees are in engineering, compared to 20 percent in Asia and around 33 percent in China. After a long period of growth, China now produces an equal or greater number of natural science and engineering doctoral degrees compared to the United States, rising four-fold from approximately 5,000 in 1997 to over 20,000 in 2007.

Moreover, large portions of these degrees in the United States are awarded to foreign students. International students received 24 percent of U.S. science and engineering master's degrees, 33 percent of science and engineering doctoral degrees, and 4 percent of science and engineering bachelor's degrees in 2007. From 2003 to 2007, the shares of the foreign-born among master's degree and doctorate holders rose two percentage points each. Twenty-five percent of all college-educated U.S. workers in science and engineering occupations in 2003 were foreign born, as were 40 percent of doctorate holders in science and engineering occupations. About half of all foreign-born scientists and engineers are from Asia, and more than a third of U.S. resident doctorate holders come from China (22 percent) and India (14 percent) combined.[22] The geographic origin of students would be less relevant to the U.S. competitive advantage if the United States were to grant all foreign-born graduates of American universities work visas. However, the U.S. employment regulations restrict the number of work visas allocated to

firms. Many foreigners resort to moving back to their home country because of these immigration regulations.[23]

In terms of technology scaling, measuring this general condition at the national level is significantly more complex and varies across sectors, but different clues can be drawn from the data. On one hand, the United States has several clear advantages. The United States claimed 67 percent of global venture capital investment in the first quarter of 2010, compared to 8 percent in China, although China's share is growing quickly. According to the World Bank's Ease of Doing Business Index, which provides insight into the ease of starting and scaling new technology-based companies, the United States ranked fourth in 2010, whereas China ranked eighty-ninth.[24] In 2005, 13 percent of all businesses in the United States were recently incorporated, compared to about 5 percent in China. On the other hand, the Chinese government provides more direct incentives for particular technology-based industries, such as direct government procurement, favorable tax conditions, and aggressive export promotion. In 2008, China's effective corporate tax rate was less than half the rate in the United States.[25] In short, the U.S. financial system is more conducive to promoting innovation, while China's direct business promotion strategies outweigh those of the United States.

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The purpose of this section was to shed light on the various factors affecting innovation in both the United States and China. Contrary to popular opinion, U.S. innovative capacity is far from being overtaken by the People's Republic of China. Given this framework, this paper now turns to exploring a key strategic industry in both countries, with the hopes of showcasing both the limitations and strengths of both China's and the United States' long-run innovative potential.

Case Study: Clean Energy Technology Innovation

Clean energy technology provides a useful case study for benchmarking the national innovation capacity of the United States and China. According to the World Economic Forum, the global clean energy market will reach $450 billion annually by 2012 and $600 billion by 2020.[26] Full market potential for clean energy products is substantially larger, with one analyst estimating Chinese market potential alone at $500 billion to $1 trillion.[27] The industry has significant national strategic importance, with President Obama declaring in his State of the Union address, "the nation that leads the clean-energy economy will be the nation that leads the global economy."[28]

In research, development, and venture capital investment, the United States is dominant, securing significantly larger levels of public and private

investment and maintaining most of the world's best public and private clean energy R&D facilities. In 2009, according to the Cleantech Group, North American companies, which are primarily based in the United States, raised $3.5 billion in clean technology venture capital, compared to $331 million by Chinese companies. California-based companies alone raised $2.1 billion in 116 deals, followed by Massachusetts ($356 million in twenty-seven deals) and Texas ($170 million in nineteen deals).[29]

The industry has significant national strategic importance, with President Obama declaring in his State of the Union address, "the nation that leads the clean-energy economy will be the nation that leads the global economy."

However, several trends suggest this dominance could be eroding, as Chinese companies attract larger amounts of other private investment. According to the same Cleantech Group report, the North American share of total global clean-tech venture capital fell from 72 percent in 2008 to 62 percent in 2009, a four-year low for the region and 42 percent less than 2008. Clean-tech M&A activity in China reached a historic high of $5.5 billion in 2009, and Chinese firms dominated clean-tech IPOs, representing half of all companies that went public and 72 percent of global clean-tech IPO proceeds. Overall, in 2009 China's clean energy sector attracted $34.6 billion in private investment, almost twice the United States, which attracted $18.6 billion.[30]

The Chinese government is targeting clean energy technology as one of its top national R&D priorities, and the country is attracting a growing number of firms to relocate their R&D facilities. In January 2010, China's National Energy Bureau announced the licensing of sixteen national clean energy R&D facilities to develop wind, nuclear, and other technologies.[31] Applied Materials, the international leader in the supply of solar cell manufacturing equipment, recently announced it would construct the world's largest and most advanced solar R&D facility in Xian, China.[32] Likewise, IBM recently decided to invest $40 million in its first "energy-and-utilities-solution lab" in China.[33]

These trends suggest that while China lacks the historical innovation capacity of the United States, the rapid scaling of its clean energy industry through large-scale technology manufacturing and deployment will attract a growing share of R&D and innovation. Indeed, China manufactures and deploys substantially more clean energy technology than the United States. For example, in 2007, China's annual solar photovoltaic (PV) and wind manufacturing capacity was 1,800 MW and 8 GW, respectively, compared to 375 MW and 4.2 GW in the United States.[34] In 2008, China produced 41 percent of the world's lithium ion batteries.

China's clean energy industry has benefited greatly from direct government incentives to support domestic market creation and enabling infrastructure. The government has set ambitious deployment targets

for solar PV, wind, nuclear, and hydroelectric energy, and one recent estimate by the Chinese government suggested the country would invest up to $738 billion in its clean energy industry over the next ten years. For example, wind turbine deployment as been supported by feed-in tariffs, mandated market shares for renewable energy, and various forms of tax rebates. China's installed annual capacity has doubled in each of the last five years, and in 2009 it led the world by installing 13 GW of new capacity. The government aims to reach 150 GW of wind turbines by 2020 and is planning sevenwind power megaprojects with a minimum capacity of 10 GW each.[35] Encouraged by its success thus far, the government has increased its 2020 solar PV target more than ten times. The Chinese Nuclear Energy Association recently projected that China would deploy 80 GW of nuclear power by 2020, double the original target established in 2007—and an impressive 200 GW by 2030.[36]

China's efforts in supportive energy infrastructure are equally impressive. China will invest approximately $300 billion over the next ten years to develop a nationwide high-speed railway system—the largest railway expansion in history—and the State Grid Corporation will invest $44 billion through 2012 and $88 billion through 2020 in ultrahigh-voltage grid infrastructure. The nation will also devote $2.9 billion from 2009-2012 to establish electric vehicle charging infrastructure.[37]

Taken together, the preceding two sections show a far murkier picture than is often portrayed in the popular press. China is indeed catching up to the United States on several accounts. Yet the United States has the latent capability to compete with China on its terms. Thus, the future of both states' innovation capacity does not rest with a fatalistic tale of American decline and Chinese triumphalism, but with the latitude of policy options available to the leaders of both countries. What matters, then, is not the stochastic process of groundbreaking innovation, but incremental policy decisions made by the leaders of both countries.

Policy Implications

Thus far, this paper has established that technological development lies at the heart of economic growth, particularly in advanced economies. Additionally, the capacity of states to use wealth-generating technological progress for the accumulation of hard power is one of the primary intervening variables of global power dynamics. International economic and technological competition is thus inevitable, given the power dynamic inherent in the international system.

Today, the United States and China share strong national interests in promoting innovation within the clean energy sector, which carries significant strategic economic and security benefits.

Today, the United States and China share strong national interests in promoting innovation within the clean energy sector, which carries significant strategic economic and security benefits. This is largely due to the short-term benefits associated with capturing clean energy market potential and reducing reliance on foreign energy imports. However, innovation in the clean energy industry also carries major positive externalities associated with the mitigation of climate change, reduction of air pollution, and development of cheaper and more distributed forms of energy to power global development.

Beyond the clean energy sector, this paper has shown that the winner of the next generation of economic competition is far from certain. Although the Chinese have played their hand well over the last decade, the United States still boasts greater latent capability for innovation than China. The challenge for the United States, then, is to convert this latent capability into useable innovative capacity. The result of this qualifying factor shows that the economic race between the United States is far from over.

Still, from the viewpoint of strategic advantage, both countries can maximize their capabilities along certain means in order to tilt the advantage to their side. The remainder of this essay argues for policy recommendations for the United States given the competitive dynamic between both countries.

Recommendations for the United States

Based on the findings reported above, we offer two broad policy recommendations—one in foreign policy, one in the domestic realm—and a warning about prophesies of American doom. Given the implications of Doran's power cycle theory and this paper's findings, the future economic relationship between the United States and the People's Republic of China will remain a situation of codependence. Furthermore, the global political economy will not be determined exclusively by China and the United States, but by an array of different agents such as India, Russia, Brazil, and the European Union. Not only should U.S. foreign policy heed the bilateral challenges posed by China, but should also consider the multilateral dimensions of great power competition. This requires the United States to pursue a multifaceted foreign policy that does not fixate exclusively on bilateral competition with one other country. In terms of great power competition, the United States should not fixate on the ever-present threat of Chinese global influence. China's rise will occur. Cold War containment strategies will likely exacerbate Chinese fears of western meddling in its affairs. Still, the biggest geopolitical shift of the twenty-first century will be seen not in the sands of Mesopotamia or mountains of Afghanistan, but in the Pacific theater. The United States should alter its foreign policy more in these lines, with greater regard to China's rising influence in the broader Asian context.

With regards to clean technology competition and broader innovation policy, the federal government should give more priority to domestic scaling of clean energy technologies, including domestic market creation and

manufacturing capacity, while producing a greater number of university graduates in energy science and engineering. U.S. dominance in energy R&D and venture capital appears relatively secure for the foreseeable future, although a growing number of experts believe the federal energy R&D budget should increase from approximately $3-5 billion to $16-20 billion annually.[38] On the other hand, the United States is falling significantly behind in deployment, manufacturing, and education. There are several ways to mitigate this. First, the United States should create a strong domestic demand that will attract leading companies to locate manufacturing, supply chain, and R&D operations in the United States; accelerate learning-by-doing to achieve improvements in price and performance, as well as manufacturing processes; and incentivize U.S. firms to invest in clean energy technology development and deployment. Even without a carbon price, the United States can stimulate demand for advanced technologies with direct government procurement, especially through the Department of Defense, and through a clean energy deployment administration, renewable portfolio standard, and targeted feed-in tariffs.

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Second, the federal government should support clean energy manufacturing, which is necessary for industry scaling, learning-by-doing, and getting technologies from the laboratory into the market. The federal government can accomplish this through low-cost financing, tax incentives, technical assistance, and direct investment. Congress can start by extending the advanced manufacturing tax credit (48C), creating a revolving manufacturing loan fund similar to the Investments for Manufacturing Progress and Clean Technology (IMPACT) Act, and leveraging the Department of Commerce's Manufacturing Extension Partnership.

We conclude with a word of caution. America has a long history of predictions of impending economic, moral, social, and ecological collapse. Some of these concerns are grounded in the real challenges facing the United States today.[39] Yet cyclical periods of cynicism have emerged throughout America's trying times. In reality, America's long-run trajectory will not be determined in a single decade and its ephemeral challenges. Instead, America's long-term success depends on its ability to withstand the uncertainty currently befalling its institutions and political system. Few other forces have caused as much unnecessary hardship as a great power acting out of raw paranoia. Unfortunately, the United States is exhibiting many symptoms of this phenomenon. It is up to the United States' leadership to see through the fog of worry and to do a realistic appraisal of America's capabilities and liabilities to forge a peaceful international order. America faces many challenges, not the least of which is pessimism. This paper intends to make

the contrarian case to this fatalism. Much as the economic race between the United States and China remains a virtual draw, so too will the general dynamic within the international system for some time.

Notes

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