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How Amplify Growth Risks for World Economies in China's Planned Economy

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Abstract

This paper examines the sustainability of China's distinct globalization model, characterized by state-driven economic policies, strategic trade practices, and assertive global investments. Although this approach has fueled impressive economic growth over recent decades, it has also exposed structural vulnerabilities that could undermine long-term stability. The analysis employs a modified Cobb-Douglas production function, integrating critical factors such as tariff dynamics, trade spillovers, and inefficiency feedback loops. This framework bridges the theoretical foundations of the Cobb-Douglas model with insights from the Solow growth model, enabling a comprehensive evaluation of China's economic trajectory.

The model suggests that China's heavy dependence on state intervention and export-driven growth risks creating inefficiencies that could lead to diminishing returns over time. High tariffs imposed by trade partners, particularly the US, exacerbate these inefficiencies by increasing production costs and reducing access to global markets. Furthermore, excessive reliance on Belt and Road Initiative (BRI) investments and state-owned enterprises (SOEs) amplifies the risks of resource misallocation and geopolitical backlash.

The paper identifies critical tipping points where inefficiency feedback loops outweigh productivity gains, potentially leading to economic stagnation or collapse. Trade spillovers, once a significant driver of innovation and growth, may dwindle as global partners diversify supply chains to reduce dependence on Chinese imports.

To ensure sustainable growth, the paper recommends a strategic pivot toward market-oriented reforms and addressing inefficiency feedback by reforming SOEs and streamlining regulatory frameworks. Additionally, capping overreliance on state-led globalization strategies and adopting a more balanced trade approach can mitigate external vulnerabilities. These policy measures are essential for China to transition from a high-growth phase to a more stable, long-term economic trajectory.

Keywords: inefficiency feedback loops, trade spillovers, structural vulnerabilities, market-oriented reforms, multifactor productivity

"China's distinct globalization model, characterized by state-driven economic policies, strategic trade practices, and assertive global investments, has fueled impressive growth but exposed structural vulnerabilities that could undermine long-term stability." Masaaki Yoshimori

1. Introduction

1.1 China's Economic Model as a Dynamic Optimization Problem

The global economic landscape has witnessed profound transformations over the past several decades, driven in part by the rise of emerging markets. Among these, China's ascendancy as a major economic power has been unparalleled, prompting extensive scholarly debate about the strategies underpinning its success. This paper explores the theoretical and empirical foundations of China's globalization model, which combines state-led industrial policies, export-oriented growth, and selective integration into global markets. By situating China's approach within the broader frameworks of economic modeling and game theory, this study aims to provide a deeper understanding of the sustainability and geopolitical implications of its developmental trajectory.

China's economic model can be viewed as a dynamic optimization problem, where policymakers strategically allocate resources across competing priorities to maximize long-term growth while maintaining political stability. The interaction of domestic and international actors within this framework reflects characteristics of a multi-player game. Domestically, the Chinese government balances the interests of state-owned enterprises (SOEs), private

firms, and local governments. Internationally, it navigates a complex web of trade relationships, geopolitical rivalries, and institutional constraints. Game-theoretic concepts such as Nash equilibrium and sequential bargaining provide valuable insights into these interactions, particularly in the context of trade negotiations, technology transfer, and China's Belt and Road Initiative (BRI).

1.2 The Role of Tariffs in Historical and Modern Contexts

Historically, tariffs played a dual role in the US, protecting emerging industries and generating federal revenue. This strategy supported infrastructure development and economic expansion. However, with the introduction of federal income taxes in 1913, the US government reduced its reliance on tariffs, enabling a more diversified fiscal approach. In the modern era, tariffs have been used strategically, such as during the U.S–China trade war, to address trade imbalances and intellectual property concerns. Whereas tariffs aim to rebuild domestic industries, they risk triggering retaliatory measures and long-term economic disruptions. The trade-offs between protectionism and economic openness remain a key policy consideration.

The US–China trade relationship has evolved from Nixon's 1972 diplomatic opening to the granting of Permanent Normal Trade Relations (PNTR) in the 1990s. This policy aimed to integrate China into the global economy, fostering stability through economic interdependence. However, China's selective compliance with international norms, particularly reducing intellectual property protection, has fueled tensions. The 2018–2020 trade war highlighted the strategic importance of high-tech sectors and China's focus on achieving technological self-sufficiency. The U.S response has involved tariffs and industrial policies to counteract China's state-driven economic model. The competition underscores the broader struggle for dominance in emerging industries critical to future economic power.

1.3 Modeling Economic Growth

This study employs a Cobb-Douglas production function to model economic growth, focusing on total factor productivity (TFP) as a key driver. TFP reflects both domestic technological progress and external trade spillovers, which are shaped by trade openness and tariff policies (Cirera et al., 2020; Yanıkkaya et al., 2022). In particular, this study incorporates tariff dynamics and structural inefficiencies into trade-driven growth models, offering a comprehensive framework to assess the complex relationship between trade policies and long-term economic trajectories.

The paper contrasts two distinct growth paradigms: market-driven globalization and China's planned-economy model. In market-driven globalization, trade enhances productivity through spillovers, with inefficiencies remaining relatively stable. By contrast, the planned-economy approach, exemplified by China's state-led globalization model (China's SLGM), generates inefficiencies that escalate disproportionately with increased trade intensity. These inefficiencies, stemming from resource misallocation, bureaucratic distortions, and self-reinforcing feedback loops, can surpass the benefits of trade, potentially leading to economic stagnation or collapse—a scenario labeled as a "broken growth trajectory."

China's globalization model is explored in depth, emphasizing its dual nature. Trade serves as a conduit for growth by facilitating technological spillovers and external knowledge transfer. However, it also intensifies inefficiencies rooted in structural distortions, such as state interventions and rigid planning mechanisms. The study identifies critical tipping points where inefficiencies outpace trade-induced benefits, destabilizing growth. Feedback loops further amplify this effect, creating a cycle of worsening inefficiency that threatens the sustainability of the growth model.

This analysis highlights the inherent vulnerabilities of state-led globalization when compared to market-driven approaches. By identifying the mechanisms through which inefficiencies accumulate, the study provides actionable insights for policymakers. To sustain growth under China's SLGM, it advocates for pursuing targeted reforms, including reducing bureaucratic barriers, optimizing resource allocation, and addressing inefficiency feedback loops. These findings are essential for understanding the trade-offs in globalization strategies and ensuring long-term economic resilience.

1.4 Game Theory and Strategic Interactions in China's Globalization

China's globalization strategy is further complicated by the interplay of domestic and international factors, which can be represented as a multi-level game (Putnam, 1988). At the domestic level, the Chinese government acts as a central planner, coordinating industrial policy and resource allocation to achieve macroeconomic stability. The dominance of SOEs in sectors such as finance, energy, and infrastructure introduces inefficiencies but also provides a mechanism for the state to maintain control over critical industries. This dynamic reflects a principal-agent problem, where the central government (principal) must align the incentives of local governments and SOEs

(agents) to implement national policies effectively.

At the international level, China's engagement with global markets can be modeled as a repeated game, where its actions in trade, investment, and diplomacy influence the strategies of other players. The US-China trade war offers a pertinent example, highlighting how tariff impositions, export controls, and retaliatory measures create a series of strategic interactions. Concepts such as tit-for-tat strategies and signaling are particularly relevant in understanding China's responses to external pressures, including its emphasis on self-reliance and technological independence through initiatives like "Made in China 2025" (Wei, Xie, & Zhang, 2017).

1.5 Research Questions and Contributions

This paper addresses the following questions. First, how does China's globalization model compare to traditional developmental state models, particularly in its balance between state intervention and market mechanisms? This comparison aims to highlight the unique features and strategies employed by China as it integrates into the global economy. Second, what are the primary challenges and inefficiencies inherent in state-led globalization? Specifically, the analysis focuses on the role of SOEs and financial repression as structural features that may hinder economic efficiency and adaptability in a rapidly evolving global landscape. Finally, how can game theory and economic modeling provide insights into the geopolitical and trade dimensions of China's strategy? This includes examining how China responds to external shocks and trade disputes, shedding light on its strategic behavior and potential outcomes in a complex international environment. By integrating theoretical perspectives from economic modeling and game theory with empirical analysis, this study aims to contribute to the growing body of literature on China's economic ascent. It seeks to evaluate the long-term sustainability of China's globalization model and its broader implications for global economic governance.

2. Literature Review

China's rise as a global economic power has been extensively studied in the context of its unique globalization model. Characterized by state-led industrialization, export-driven growth, and strategic trade policies, this model has drawn comparisons to both the East Asian developmental state model and traditional command economies. Scholars have debated the long-term viability of this approach, highlighting its successes and potential pitfalls.

2.1 Historical Context and Theoretical Foundations

The roots of China's globalization model can be traced back to Deng Xiaoping's economic reforms in the late 1970s, which introduced market-oriented policies within a socialist framework (Brandt & Rawski, 2008; Lardy, 2006). These reforms emphasized "opening up" the economy, allowing foreign direct investment (FDI), and developing special economic zones (SEZs) (Wang, 2013). The subsequent decades saw significant growth driven by export-oriented industrialization, facilitated by China's accession to the World Trade Organization (WTO) in 2001 (Subramanian & Wei, 2007). This pivotal moment accelerated China's integration into global value chains, making it a hub for manufacturing and trade (Chor *et al*. 2020).

Theoretically, China's globalization model aligns with aspects of developmental state theory (Johnson, 1982), which emphasizes state intervention in industrial policy and economic planning. However, the model's hybrid nature—combining market reforms with authoritarian governance and SOEs—has led scholars to describe it as "state capitalism" (Bremmer, 2010). This approach leverages state control to direct resources into strategic sectors while maintaining tight political oversight.

Critics, however, have highlighted the limitations of this model. Huang (2008) argues that state capitalism may stifle long-term innovation and efficiency due to the dominance of SOEs and bureaucratic inefficiencies. Persistent resource misallocation, often referred to as "financial repression," has resulted in preferential capital allocation to SOEs, thereby crowding out private-sector investment (Wu, 2018; Zhao, 2018).

2.2 Economic Drivers and Successes

China's integration into global markets has been underpinned by its comparative advantages in low-cost manufacturing, economies of scale, and strategic trade policies. These factors, combined with significant investments in infrastructure, education, and technology, have created a foundation for sustained economic growth (Rodrik, 2006). The BRI, launched in 2013, represents an extension of this strategy. Through infrastructure investments across Asia, Africa, and Europe, the BRI seeks to secure trade routes and expand market access (Hurley, Morris, & Portelance, 2018).

Empirical studies highlight the benefits of China's globalization model. Lin (2011) underscores the role of state-led investments in driving economic transformation, particularly through urbanization and industrial upgrading. Naughton (2007) emphasizes policy flexibility—a hallmark of China's approach—which has enabled rapid

adjustments to global economic shifts. Furthermore, the establishment of SEZs, such as Shenzhen, has fostered innovation and attracted foreign investment, serving as engines of regional and national growth.

2.3 Challenges and Critiques

Despite its successes, China's globalization model faces significant challenges. One critical issue is the inefficiency of SOEs, which dominate key sectors despite being less productive than private enterprises (Hsieh & Klenow, 2009). This inefficiency creates a feedback loop of stagnation, with SOEs receiving preferential treatment in capital allocation, limiting competition and innovation.

The sustainability of export-driven growth is another concern. As global demand slows and trade tensions rise, particularly with the US, scholars like Zhang (2020) argue that China must transition to a consumption-driven and innovation-led economy. The dual circulation strategy, introduced in 2020, reflects an acknowledgment of these vulnerabilities by emphasizing domestic market development alongside global engagement (Chen, 2021). However, its effectiveness remains uncertain, with critics questioning whether domestic consumption can sufficiently offset declining exports.

Geopolitical risks associated with the BRI have also been widely discussed. Hurley, Morris, and Portelance (2018) highlight concerns over debt sustainability, as many recipient countries face difficulties repaying Chinese loans. Additionally, geopolitical backlash, particularly from Western powers, has raised questions about the long-term viability of China's global economic strategy.

2.4 Geopolitical and Trade Dimensions

The US-China trade war has exposed vulnerabilities in China's globalization model. Tariffs and export controls imposed by the US have disrupted supply chains and highlighted China's reliance on foreign technology, particularly in critical sectors such as semiconductors (Friedberg, 2011). Baldwin and Evenett (2020) argue that these disruptions underscore the limitations of a globalization model heavily dependent on external markets and technologies.

In response, China has introduced policies aimed at fostering self-reliance and technological independence, exemplified by the "Made in China 2025" initiative. This strategy seeks to reduce dependence on foreign inputs by prioritizing innovation in high-tech industries such as artificial intelligence, renewable energy, and aerospace (Wei, Xie, & Zhang, 2017). A crucial aspect of this technological push is securing access to rare-earth elements—such as lithium, cobalt, and neodymium—which are essential for semiconductors, electric vehicle batteries, and advanced weapon systems (Golev *et al*. (2014).

China's dominance in the rare earth supply chain has significant geopolitical and economic implications, as it maintains control over both mining and processing capacities, limiting other countries' ability to secure independent supply chains (Kiggins, 2015). Rare metals are critical for defense technologies, renewable energy, and advanced electronics, giving China substantial economic leverage and strategic power in global markets (Mancheri, 2015).

Additionally, China has historically used export restrictions as a geopolitical tool, exemplified by the 2010 export cuts to Japan during territorial disputes, which created supply shocks and price volatility (Evenett & Fritz, 2023**)**. These restrictions not only disrupt industries reliant on rare metals but also compel other nations to seek alternative sources, though the significant time and investment required for developing new mining and refining capacities further reinforce China's strategic advantage. As a result, rare metal supply chains remain central to global economic and strategic maneuvering, with China's established dominance continuing to shape international trade policies and industrial strategies (Mancheri *et al*., 2019).

2.5 Comparative Perspectives

Comparisons with other East Asian developmental states, such as South Korea and Japan, offer valuable insights into the evolution of globalization models. Both countries successfully transitioned from export-led growth to domestic consumption and high-value industries (Amsden, 1989). Key differences include the role of private enterprises and the gradual reduction of state intervention. In contrast, China's economy remains characterized by significant state control and limited private-sector autonomy (Naughton, 2007).

While extensive research exists on China's globalization model (Feng, 2019; Wei & Liefner, 2012), several gaps remain. First, there is limited empirical analysis of the long-term impact of inefficiency feedback loops on economic growth. Second, the geopolitical implications of China's globalization strategy, particularly in the context of the BRI, require further investigation. Finally, the effectiveness of recent policy shifts, such as the dual circulation strategy, has yet to be fully evaluated. Addressing these gaps is essential for understanding the

sustainability of China's economic trajectory.

The literature on China's globalization model offers a nuanced understanding of its achievements and challenges. State-led strategies have propelled China's rise, but the sustainability of this model depends on addressing inefficiencies, fostering innovation, and navigating geopolitical tensions. Future research should focus on empirical evaluations of reform efforts and their implications for global economic dynamics, particularly in light of evolving trade and technological paradigms.

3. Theoretical Framework

3.1 Model

Production Function

Economic growth is represented by the standard Cobb-Douglas production function, widely used in growth and trade economics due to its simplicity and empirical support (Solow, 1956; Romer, 1990):

$$\mathrm{Y(t)} = \mathrm{A(t)K(t)^{\beta}L(t)^{1-\beta}} \quad (1)$$

Where: $Y(t)$: Output at time t. $K(t)$: Capital stock. $L(t)$: Labor force. $A(t)$: Total factor productivity (TFP), capturing technological progress and spillovers. $\beta \in (0,1)$: Capital share of output. The decomposition of TFP into trade spillovers, R&D, and inefficiencies is a distinguishing feature of this paper, building on foundational works (Grossman & Helpman, 1991; Acemoglu, 2009).

Technology Growth with Tariff Dynamics

Building on the literature on trade and growth, TFP is modeled to evolve through a combination of domestic innovation and external spillovers, influenced by trade openness (Coe & Helpman, 1995; Melitz, 2003):

$$\frac{\dot{A}(t)b}{A(t)b} = \phi R(t) + \theta T(t) - \eta\Delta(t) \quad (2)$$

Where: $\phi R(t)$: Contribution of domestic R&D. $\theta T(t)$: Trade-driven technology spillovers, influenced by tariff rates (τ). $\eta\Delta(t)$: Losses from inefficiencies in resource allocation and market distortions due to China's planned economy.

This explicit integration of tariff dynamics into trade-driven spillovers is an original contribution, expanding on prior trade-focused growth models (e.g., Krugman, 1991).

Trade spillovers are modeled as:

$$T(t) = F(t) \cdot (1-\tau) \quad (3)$$

Where: $F(t)$: Trade intensity. τ: Tariff rate, with lower tariffs increasing $T(t)$.

Long-Term Growth Dynamics

The steady-state the equilibrium growth rate (g^*) derived from the production function and TFP dynamics is expressed as:

$$g^* = \frac{\phi R^* + \theta F^*(1-\tau) - \eta\Delta}{1-\beta} \quad (3)$$

This equation synthesizes: The contribution of domestic innovation (R^*). Gains from trade intensity $F^*(1-\tau)$, contingent on optimal tariff policies. Losses from systemic inefficiencies (Δ) inherent in planned economies.

The steady-state model provides a structured way to evaluate policy interventions aimed at boosting g^*.

Planned Economy vs. Globalization

China's Planned Economy: Inefficiencies (Δ) grow non-linearly with trade intensity:

$$\Delta = \psi F^{\rho}, \psi > 0, \rho > 1 \quad (4)$$

This results in diminishing returns to trade beyond a threshold.

Globalization Model: Inefficiencies are either constant or decline with trade:

$$\Delta = \psi_0, \ \psi_0 \geq 0 \quad (5)$$

Here, long-term growth benefits from sustained trade-driven technology spillovers.

Long-Term Growth Behavior

Under China's Planned Economy

As trade intensity (F) grows indefinitely:

$$g^*_{planned} \rightarrow -\infty \ (if\ \rho > 1) \tag{6}$$

This reflects the risk of growth collapse when inefficiencies outweigh spillover benefits.

Under Market-Driven Globalization

For constant inefficiencies (ψ_0):

$$g^*_{planned} \rightarrow \frac{\theta(1-\tau)}{1-\beta} \tag{7}$$

Refined Model Framework: **A Detailed Examination of China's Globalization Model (CGM)**

The objective of this analysis is to explicitly test whether China's globalization model (CGM) leads to a "broken growth trajectory," a scenario where long-term economic growth is impeded by inefficiencies and distortions inherent in CGM. To capture these dynamics, the standard growth model equations are modified to include elements specific to CGM, such as technology transfer mechanisms, inefficiencies resulting from resource misallocation, and dynamic feedback effects.

Key Distinctions in China's Globalization Model (CGM)

China's approach to globalization involves a state-led model where technology transfer, trade intensity, and structural inefficiencies play pivotal roles in shaping the growth trajectory of both China and its trade partners, particularly developing economies. The model focuses on three key aspects:

1. China-Specific Spillovers (T_C): These represent the technology transfer under China's state-controlled system, which significantly influences the growth rates of trading partners.
2. Inefficiencies (Δ_C): These inefficiencies arise due to overinvestment in certain sectors, misallocation of resources, and distortions associated with China's planned economy, which affect not only domestic outcomes but also spill over to global trade dynamics.
3. Dynamic Feedback Effects (λ): These feedback loops intensify inefficiencies over time, creating a cyclical pattern where higher trade intensity leads to greater inefficiencies, which in turn stifle growth in a self-perpetuating manner.

Modified Growth Model

The growth rate $g(t)$ of developing economies under CGM is modeled as:

$$g(t) = \frac{\phi R(t) + \theta_c T_c(t) - \eta_c \Delta_c(t)}{1-\beta} \tag{8}$$

Where: $\phi R(t)$: Represents the contribution of domestic research and development (R&D). $\theta_c T_c(t)$: The technology spillovers from China, where $T_c(t)$ is the trade-driven technology transfer, and θ_c captures the effectiveness of these spillovers. $\eta_c \Delta_c(t)$: The losses associated with inefficiencies stemming from China's planned economy. β: The output elasticity of capital, capturing the contribution of capital to growth.

The technology spillovers $T_c(t)$ are defined as:

$$T_c(t) = \alpha_c F(t)(1-\tau) - \kappa_c \Delta_c(t) \tag{9}$$

Where: α_c represents the effectiveness of technology spillovers from CGM. $F(t)$ is trade intensity, which is influenced by both the level of trade and tariff rates τ. κ_c represents the degradation of these spillovers due to inefficiencies $\Delta_c(t)$.

$$\Delta_c(t) = \psi_c F(t)^{\rho} + \lambda \Delta_c(t-1) \tag{10}$$

Where: ψ_c captures the magnitude of inefficiencies proportional to trade intensity $F(t)$. ρ captures the non-linearity of inefficiencies, indicating that inefficiencies increase more than proportionally with trade intensity. λ is the feedback parameter that indicates how past inefficiencies influence current inefficiencies.

Solving the Model for Long-Term Growth

This section derives the steady-state growth rate (g^*) within the modified framework, which incorporates key characteristics of China's globalization model (CGM). The focus is on whether the CGM leads to a breakdown of growth dynamics through inefficiencies and feedback loops.

Trade Spillover Equation

The growth rate $g(t)$ is given as:

$$g(t) = \frac{\phi R(t) + \theta_c T_c(t) - \eta_c \Delta_c(t)}{1-\beta} \tag{11}$$

Substituting the expression for technology spillovers $T_c(t)$:

$$T_c(t) = \alpha_c F(t)(1-\tau) - \kappa_c \Delta_c(t) \tag{12}$$

Grouping the terms results in:

$$g(t) = \frac{\phi R(t) + \theta_c [\alpha_c T_c(t)(1-\tau) - \kappa_c \Delta_c(t)] - \eta_c \Delta_c(t)}{1-\beta} \tag{13}$$

Grouping terms yields:

$$g(t) = \frac{\phi R(t) + \theta_c \alpha_c T_c(t) - (\theta_c \kappa_c + \eta_c)\Delta_c(t)}{1-\beta} \tag{14}$$

This equation highlights the trade-off between technology spillovers $\theta_c \alpha_c T_c(t)(1-\tau)$ and the losses due to inefficiencies $((\theta_c \kappa_c + \eta_c)\Delta_c(t))$.

Inefficiency Dynamics:

The inefficiencies $\Delta_c(t)$ evolve according to:

$$\Delta_c(t) = \psi_c F(t)^{\rho} + \lambda \Delta_c(t-1) \tag{15}$$

In the steady state, $\Delta_c(t) = \Delta_c(t-1) = \Delta_c^*$, the equation simplifies to:

$$\Delta_c^* = \frac{\psi_c F^{*\rho}}{1-\lambda}, \text{ if } \lambda < 1 \tag{16}$$

This steady-state inefficiency expression indicates that Δ_c^* depends on trade intensity (F^*), the non-linearity of inefficiency growth (ρ), and the feedback effect (λ). A higher λ amplifies inefficiencies over time, particularly when $\rho > 1$.

Steady-State Growth Rate

Substituting Δ_c^* into the growth rate equation, the steady-state growth rate (g^*) is:

$$g^* = \frac{\phi R^* + \theta_c \alpha_c F^*(1-\tau) - (\theta_c \kappa_c + \eta_c)\Delta_c^*}{1-\beta} \tag{17}$$

Replacing Δ_c^* with its steady-state value:

$$g^* = \frac{\phi R^* + \theta_c \alpha_c F^*(1-\tau) - (\theta_c \kappa_c + \eta_c)\left(\frac{\psi_c F^{*\rho}}{1-\lambda}\right)}{1-\beta} \tag{18}$$

This expression captures the steady-state growth as a function of R&D contributions (ϕR^*), trade-driven spillovers $\theta_c \alpha_c F^*(1-\tau)$, and the inefficiency losses $((\theta_c \kappa_c + \eta_c)\,\Delta_c^*)$.

Key Insights from the Solution

CGM-Specific Threshold Effects: If $\rho > 1$ inefficiencies grow disproportionately with trade intensity (F^*), then the cost of inefficiencies can become much larger than the benefits derived from trade and technology spillovers. This introduces a potential "tipping point" where growth turns negative.

Feedback Loop Exacerbates Inefficiencies: The presence of $\lambda > 0$ introduces a feedback loop that exacerbates inefficiencies over time. Higher trade intensity leads to greater inefficiencies, which in turn reduce the effectiveness of future trade and technology spillovers. This makes Δ_c^* unstable and can destabilize growth.

Comparison with General Globalization: in contrast, under general globalization, where ψ_c is small; $\rho \approx 1$, and $\lambda = 0$; inefficiencies are less pronounced; and the growth trajectory remains stable. In such cases, the system exhibits more predictable behavior, and growth remains positive. Under CGM, the combination of high ψ_c, $\rho \gg 1$, and $\lambda > 0$ risks making g^* negative, indicating a broken growth model.

Conditions for Broken Growth**:** The growth model breaks down when inefficiency losses outweigh the combined benefits from R&D and trade spillovers. Mathematically, this occurs when:

$$(\theta_c \kappa_c + \eta_c)\left(\frac{\psi_c F^* \rho}{1-\lambda}\right) > \phi R^* + \theta_c \alpha_c F^* (1-\tau) \quad (19)$$

If this condition is satisfied, the steady-state growth rate (g^*) becomes negative, indicating a "broken growth model."

Limiting Overreliance on China: To prevent the breakdown of the growth model, developing economies should consider limiting their dependence on China by either capping trade intensity F^* or diversifying their trade partnerships. Overreliance on a single trade partner can exacerbate the inefficiencies and distortions in the economy, leading to a negative growth trajectory.

Reducing Feedback Effects: Policy reforms aimed at reducing the feedback effects λ would be crucial in stabilizing the growth trajectory. This could involve reforming China's trade practices or fostering more balanced international trade relationships.

Fostering Domestic Innovation: Encouraging domestic innovation (captured by R^*) would help reduce the dependency on external technology spillovers and mitigate the risks associated with inefficiencies. Countries that foster innovation at home will be better positioned to counteract the negative feedback loops that arise from excessive reliance on foreign trade and technology.

This model provides a framework to evaluate whether China's globalization model creates risks for developing economies. The key takeaway is that excessive trade intensity, coupled with inefficiencies and dynamic feedback loops, can destabilize growth, leading to a "broken" growth trajectory. Policymakers in developing economies need to carefully manage trade dependencies, reduce inefficiencies, and foster domestic innovation to avoid these risks.

Risks of China's Planned Economy

China's state-led economic model presents a double-edged sword. On one hand, centralized planning has enabled rapid infrastructure development and technological advancements, solidifying China's position as a global trade leader. Strategic resource allocation under this framework has accelerated the country's growth in emerging industries such as renewable energy, advanced manufacturing, and artificial intelligence. However, this model also harbors inherent inefficiencies $\Delta_c(t)$ that threaten long-term growth. The centralized approach often leads to overinvestment in low-yield sectors, misallocation of capital, and pronounced regional disparities. These inefficiencies, initially offset by high growth rates, tend to accumulate over time, resulting in diminishing returns. Moreover, the rigidity of China's planned economy constrains its ability to adapt to external shocks, such as shifts in global supply chains or financial crises.

Looking forward, the risks associated with China's economic model are likely to intensify as the country faces mounting structural and external pressures. Demographic challenges, such as a shrinking workforce and an aging population, may erode labor productivity and strain fiscal resources. Simultaneously, rising geopolitical tensions and trade barriers could undermine China's reliance on export-led strategies, necessitating a pivot towards domestic demand and innovation. Additionally, whereas China has achieved remarkable progress in technology, the risk of diminishing returns on R&D and potential constraints on global technology transfers could hinder sustained advancements. To navigate these challenges, China could address its structural inefficiencies by fostering market competition, decentralizing economic decision-making, and prioritizing regional equity. Without such reforms, the long-term risks may overshadow the benefits of its current growth trajectory, leading to stagnation or even negative growth outcomes.

The Chinese government's centralized approach can lead to overinvestment in low-yield sectors, misallocation of capital, and widening regional disparities. While these inefficiencies may be initially masked by high growth rates, they tend to accumulate over time, ultimately resulting in diminishing returns.

3.2 Discussion: DeepSeek's Growth Sustainability in the Context of US-China AI Rivalry

The rise of DeepSeek as an efficient and cost-effective AI model provider underscores China's strategic advancements in artificial intelligence. However, its ability to sustain efficiency and low costs amidst global competition hinges on multiple economic and business factors. Lower trade barriers, particularly through tariff reductions (τ), have historically enhanced trade intensity (T), stimulating economic expansion in export-driven economies like China (Krugman, 1991). While initial tariff reductions bolster cross-border exchanges and capital inflows, their long-term benefits depend on reinvestment in productivity-enhancing sectors. In the AI sector, China's ability to maintain an edge through government support and domestic market dominance will be crucial in mitigating vulnerabilities associated with increased global protectionism and deglobalization trends (Rodrik, 2018).

As DeepSeek scales, infrastructure and compute costs represent a significant challenge. AI models require extensive computational power, and US firms such as Google possess vast cloud infrastructures that enable cost absorption and price competition. Economies of scale and strategic partnerships with domestic cloud providers, such as Alibaba Cloud or Tencent Cloud, may help DeepSeek mitigate rising costs and maintain a competitive advantage (Bresnahan & Trajtenberg, 1995). However, efficiency gains alone may not suffice if US firms rapidly adopt similar optimizations, necessitating continuous innovation in model architecture and hardware utilization (Hennessy & Patterson, 2019; Thompson, *et al.*, 2020).

Trump's comments on DeepSeek's rise reflect growing concerns over China's rapid advancements in AI, which he described as a "wake-up call" for US industries. He noted the challenge posed by China's ability to develop more efficient and cost-effective AI solutions, emphasizing the need for the US to remain "laser-focused" on innovation and maintaining a competitive edge (TIME, 2025). This aligns with broader geopolitical strategies pursued during the Biden administration, where technological competition with China was a key focus. In response to China's growing AI prowess, US policymakers have considered imposing export controls on critical technologies, such as Nvidia chips, which are essential to AI models like DeepSeek's (Allen, 2024). Such measures aim to limit China's access to cutting-edge hardware and slow its AI advancements (Reuters, 2025).

The main concern among American politicians regarding DeepSeek's release stems from its ability to develop and train an AI model. DeepSeek used innovative hardware and software techniques to achieve leading-edge results on lower-performance Nvidia GPUs, which might not be subject to these controls. Restrictions on access to these technologies would directly impact its operational efficiency and cost structure. In response, China has been accelerating its push toward semiconductor self-sufficiency, driven by geopolitical tensions, with initiatives like "Made in China 2025" (The State Council of the People's Republic of China, 2015) focusing on building a strong domestic semiconductor industry. As the US contemplates further restrictions, it is likely to intensify pressure on Chinese companies to innovate and develop homegrown alternatives, reshaping the competitive landscape in AI technology

Further complicating DeepSeek's growth trajectory is the intensifying technological decoupling between the US and China. Expanding export controls and urging allies to impose trade barriers against Chinese tech firms limit DeepSeek's international market access. While China's protected domestic market provides a buffer, the firm's ability to monetize AI services beyond national borders remains uncertain. To counteract these challenges, DeepSeek may need to prioritize partnerships in Asia and emerging markets, leveraging China's broader BRI to sustain demand for AI-driven solutions in finance, healthcare, and industrial automation.

Ultimately, DeepSeek's long-term sustainability hinges on its ability to carve out a niche within a shifting global landscape. If it can secure dominance within China and expand regionally before US competitors gain traction, it may sustain a competitive position. However, the interplay of rising costs, geopolitical restrictions, and aggressive innovation from US tech giants underscores the precarious nature of its future growth. In an era where technological supremacy intersects with national security concerns, DeepSeek's trajectory will be shaped not only by business strategy but also by macroeconomic policies and geopolitical maneuvering.

4. China-US Strategic Competition: A Game Theoretic Analysis with a Focus on Tariffs

The evolving competition between the United States and China can be conceptualized as a dynamic multi-stage game where each player seeks to maximize long-term payoffs across multiple dimensions: economic growth, technological dominance, and geopolitical influence. This analysis adopts game theory tools, including dynamic non-cooperative games, repeated games, and evolutionary stability, to analyze the strategic interplay and potential equilibria.

4.1. Multi-Dimensional Strategic Framework

The strategic competition is modeled as a two-player game with China and the United States pursuing distinct but interdependent objectives.

China's payoff function is defined as:

$$\Pi_c = U_c(T(F), R, \Delta, G) \tag{20}$$

where $T(F)$ represents trade-driven economic growth, R reflects domestic innovation capacity, Δ denotes inefficiencies within a state-led economic model, and G captures geopolitical influence, particularly through initiatives such as BRI. China's strategy involves balancing trade partnerships, domestic reforms, and geopolitical capital to sustain growth and mitigate the adverse impacts of tariffs.

The United States' payoff function is expressed as:

$$\Pi_{US} = U_{US}(M, T(F), S, L) \quad (21)$$

where M indicates monetary dominance via the US. dollar's role as the global reserve currency, $T(F)$ reflects trade flows with China, including the impact of tariffs, S represents the strength and breadth of strategic alliances, and L captures domestic economic resilience and innovation capacity. The US strategy focuses on leveraging tariffs to protect critical industries, reinforcing alliances, and maintaining technological leadership.

4.2 Repeated-Game with Tariff Trade-Offs

The competition unfolds as an infinitely repeated-game. In the stage game, each player has two pure strategies, Engage and Contain, with payoffs shown in the table below. The pure strategies are high-level abstractions that encompass trade, tariffs, innovation, and geopolitical actions. The repeated-game dynamic allows for strategic considerations beyond immediate payoffs, influencing long-term behavior and equilibrium outcomes.

Table 1. Game Matrix

China/US	Engage	Contain (Tariff)
Engage	(4,4)	(2,5)
Contain (Tariff)	(5,2)	-1.1

The numerical playoffs are based on economic and strategic considerations: (4,4) represents mutual cooperation with high gains; (2,5) and (5,2) reflect short-term advantages for one player imposing tariffs while the other engages; and (-1,-1) captures the mutually harmful effects of sustained tariff escalation, reflecting reduced trade, inefficiencies, and economic stagnation (Table 1).

The repeated game framework highlights the persistent trade-offs between economic cooperation and geopolitical competition. This model provides a structured approach to understanding the evolving US-China trade dynamic.

The repeated-game framework highlights the persistent trade-offs between economic cooperation and geopolitical competition. By allowing players to condition their actions on past behavior, this framework accounts for strategies involving retaliation and long-term incentives. In the context of US-China trade relations, repeated interactions shape the evolution of policies, with cooperation or conflict emerging based on expectations of future responses.

Moreover, this framework underscores how credibility and commitment influence long-term strategic decisions. The ability to sustain cooperation depends not only on immediate economic incentives but also on the expectation of future benefits or costs. As trade disputes and policy shifts unfold, states continuously reassess their strategies, adjusting to signals from their counterparts. This dynamic process highlights the role of institutional mechanisms, diplomatic negotiations, and economic interdependencies in shaping the trajectory of bilateral relations.

The broader policy implications of these results emphasize the necessity of institutional frameworks that enforce cooperation and mitigate the risks of defection. Global trade agreements and enforcement bodies such as the World Trade Organization (WTO) play a crucial role in stabilizing expectations and ensuring compliance, thereby reducing the likelihood of tariff escalation (Yoshimori, 2024). However, the model also implies that external shocks, such as geopolitical instability or economic crises, could alter discount factors and shift strategic incentives, potentially destabilizing cooperative equilibria.

4.3 Discussion

In real-world interactions with China, the US has primarily employed a strategy of "strategic pressure through economic leverage," characterized by tariffs, export controls, and industrial policies designed to limit China's technological progress while strengthening domestic industries. In response, China has adopted a counter-strategy of "economic resilience and retaliatory countermeasures," leveraging diversified trade partnerships, retaliatory tariffs, and domestic industrial policies to mitigate US pressure.

The US has intensified efforts to restrict China's access to cutting-edge semiconductor technology, evident in export bans targeting firms like Huawei and SMIC, as well as legislative measures such as the CHIPS Act (Shivakumar *et al*., 2024; The United States Announces Export Controls to Restrict China's Ability to Purchase and Manufacture High-End Chips, 2023). China, in turn, has accelerated domestic semiconductor development and sought alternative supply chains to reduce dependency on US firms. This strategic interaction suggests that while economic interdependence persists, the U.S. aims to selectively decouple from China in critical sectors, reflecting a shift from broad trade protectionism to targeted economic containment. Such a transition highlights the growing significance of technological self-sufficiency and supply chain security as central elements in the

broader geopolitical competition.

From a game-theoretic perspective, the current state of the US-China economic relations can be understood as a constrained Nash equilibrium, where neither side has a strong incentive to unilaterally shift strategies due to the high costs of escalation. The US avoids excessive economic decoupling due to inflationary pressures and the lobbying power of multinational corporations, while China refrains from aggressive retaliatory measures that could disrupt its long-term economic planning.

4.4 Dynamic Non-Cooperative Game

Players maximize long-term payoffs, factoring in the impact of tariffs on trade and innovation, inefficiencies, and geopolitical capital:

$$max_{s_i} \int_0^{\infty} e^{-\delta t}\, \Pi_i \left(s_i, s_j, x(t)\right) dt \tag{22}$$

Where $\mathrm{x(t)}$ denotes state variables such as economic growth $\mathrm{x(t)}$, inefficiencies (Δ), geopolitical capital $\mathrm{x(t)}$, s_i represents the strategy choices (Engage, Contain, or Retaliate), and (δ) is the discount factor reflecting future payoff valuation.

4.5 Strategic Interdependencies

Trade and tariffs are central to the interaction. China seeks to mitigate tariff-related inefficiencies (Δ) by reforming domestic industries and diversifying trade partnerships across Association of Southeast Asian Nations (ASEAN), Africa, and Latin America. Concurrently, the United States implements tariffs to protect critical industries and incentivizes reshoring to reduce dependence on Chinese imports. This dynamic interplay influences innovation spillovers, economic growth, and global trade flows.

Geopolitical influence amplifies these trade dynamics. China leverages the BRI and institutions like Brazil, Russia, India, China, and South Africa (BRICS) and Asian Infrastructure Investment Bank (AIIB) to consolidate its regional dominance, while the US fortifies alliances through North Atlantic Treaty Organization (NATO), Quadrilateral Security Dialogue (QUAD), and Australia-United Kingdom-United States Security Partnership (AUKUS), using tariffs as bargaining tools in trade negotiations.

4.6 Evolutionary Stability and Tipping Points

Evolutionary Stable Strategies (ESS) emerge when neither player can unilaterally improve their payoff. For China, this entails expanding trade dominance $T(F)$ and reducing inefficiencies (Δ). For the United States, the ESS includes strategic tariffs, strengthening alliances, and fostering domestic innovation. Tipping points occur when excessive reliance on tariffs increases costs for US consumers or isolates both nations from global innovation networks, undermining long-term stability.

4.7 Policy Implications and Global Payoffs

The competition reflects a stag hunt game, where mutual cooperation through balanced tariff and trade policies maximizes global payoffs. However, distrust incentivizes containment through tariffs and decoupling strategies.

By employing tariffs strategically, fostering alliances, and prioritizing innovation, the US can stabilize its position while mitigating risks of overreach. For China, addressing internal inefficiencies and countering tariff impacts are crucial for sustaining growth. This nuanced game-theoretic framework highlights pathways for both nations to manage rivalry while minimizing global instability.

4.8 Should US Implement Do High Tariffs?

The debate over whether the United States should implement high tariffs is a critical one, particularly in the context of economic competition with China and the broader implications for global trade. Proponents of high tariffs argue that they protect domestic industries, reduce reliance on foreign imports, and address unfair trade practices. For example, in strategic sectors like semiconductors, high tariffs can shield nascent industries, enabling innovation in a protected market (Autor *et al*., 2020). Moreover, tariffs serve as leverage in trade negotiations, pressuring trading partners to adopt fairer practices, as seen in the US-China trade tensions (Bown, 2020).

However, high tariffs also pose significant economic risks. They increase the cost of imported goods, leading to higher consumer prices and reduced purchasing power, particularly for low- and middle-income households (Fajgelbaum *et al*., 2020). Historical evidence, such as the Smoot-Hawley Tariff Act of 1930, demonstrates how protectionist policies can exacerbate economic downturns and global instability (Irwin, 2017). Additionally, such tariffs can disrupt supply chains, increasing costs for businesses that rely on imported materials. They may also lead to job losses in export-dependent industries as other countries impose retaliatory trade barriers.

Moreover, high tariffs disrupt global supply chains, which are integral to modern economic systems. Increased

costs of production inputs reduce the competitiveness of US firms and limit access to advanced foreign technologies (Antràs & Chor, 2021). This is especially problematic in high-tech industries, where collaboration and global sourcing are essential for innovation. Additionally, unilateral high tariffs risk isolating the US from its allies, undermining efforts to build multilateral coalitions to counter China's economic practices (Ikenberry, 2018).

A more strategic approach could mitigate these challenges while addressing the US's economic and geopolitical objectives. Targeted tariffs on non-essential imports, combined with incentives for reshoring and diversifying supply chains, can protect critical sectors without unduly harming consumers (Grossman & Helpman, 2021). Coordinating tariff policies with allies would amplify their effectiveness and reduce the likelihood of retaliation, fostering a unified approach to addressing shared concerns about China's economic practices (Baldwin, 2020). Additionally, long-term investments in research and development are essential for maintaining the US's competitive edge (Aghion *et al*., 2021).

In conclusion, high tariffs have their merits as a policy tool. However, their broad application risks unintended consequences, including higher consumer costs, supply chain disruptions, and strained international relations. A balanced and collaborative approach that emphasizes strategic tariffs, supply chain diversification, and innovation would better position the US to achieve its economic and geopolitical goals in a competitive global environment (Yoshimori, 2024).

5. Conclusion

The model confirms that China's globalization approach risks leading to a "broken growth model" for developing economies due to inefficiency feedback loops and non-linear growth effects. In contrast, general globalization offers more stable long-term growth because it avoids significant inefficiency dynamics. For developing economies, adopting strategic trade policies and investments in domestic innovation is crucial to mitigating these risks.

China's state-led globalization model has achieved remarkable economic growth, propelling the nation to a pivotal position within the global economy. However, the sustainability of this model is under increasing scrutiny as structural inefficiencies, geopolitical tensions, and evolving global dynamics create significant pressures. This paper's analysis highlights the critical vulnerabilities of China's approach while offering insights into alternative strategies for future development.

China's economic model, once the engine of its rapid industrialization and global ascendancy, now faces substantial structural challenges that threaten its long-term viability. Domestically, the reliance on state intervention and the dominance of state-owned enterprises (SOEs) have entrenched inefficiencies, distorted resource allocation, and limited the potential for market-driven growth. The centralized allocation of resources has frequently resulted in misallocations that stifle productivity, innovation, and economic flexibility. These inefficiencies, if left unaddressed, could undermine China's economic stability and growth prospects, particularly as the country attempts to navigate an increasingly complex global landscape.

Externally, rising geopolitical tensions further complicate China's economic strategy. Trade disputes and economic decoupling efforts, most notably led by the United States, have exposed the vulnerabilities of China's export-dependent strategy. These challenges have driven up production costs, constrained access to vital markets, and magnified the fragility of a growth model heavily reliant on external demand. The BRI, a cornerstone of China's global strategy, has further amplified these vulnerabilities. While the BRI has been instrumental in expanding China's global influence, it has also subjected the country to geopolitical backlash, heightened risks of default from economically or politically unstable partner nations and diminishing returns on infrastructure investments in these regions.

To address these multifaceted challenges, China must pursue comprehensive and targeted reforms. Domestically, improving resource allocation and fostering a more dynamic economic environment are essential. This requires streamlining regulatory frameworks to reduce bureaucratic inefficiencies, enhancing the governance of SOEs through corporate reforms, and selectively privatizing state enterprises to improve their accountability and profitability. A shift toward policies that prioritize domestic consumption over export-driven growth can provide a more stable foundation for sustainable economic development. Encouraging market-driven mechanisms and fostering greater competition within the private sector will also be pivotal in unlocking the potential for long-term growth and innovation.

A transition from its current state-led globalization model to a more balanced and sustainable approach will not only benefit China but also provide a more stable framework for developing economies to engage with global markets. Developing countries, in particular, must recognize the risks associated with emulating China's model

and instead focus on adopting strategic trade policies, fostering domestic innovation, and building resilient economic structures that are less susceptible to inefficiency feedback loops.

China's economic trajectory is at a critical juncture, but its path forward is riddled with contradictions and systemic risks. While Beijing has demonstrated remarkable adaptability, its heavy reliance on state intervention, top-down economic planning, and opaque governance raises serious concerns about long-term sustainability. The persistence of structural inefficiencies, such as overcapacity in key industries, a fragile real estate sector, and mounting local government debt, exposes vulnerabilities that cannot be indefinitely papered over by state support.

Moreover, China's selective approach to globalization—championing free trade when convenient while maintaining protectionist policies at home—undermines the credibility of its commitment to genuine international economic cooperation. The growing role of SOEs and regulatory crackdowns on the private sector have stifled innovation and investor confidence, casting doubt on China's ability to foster a truly dynamic, market-driven economy.

For global policymakers, the Chinese model serves as both a lesson and a warning: excessive state control can yield short-term stability but often at the cost of long-term economic resilience and inclusivity. Without meaningful structural reforms and a genuine embrace of market liberalization, China risks not only slowing its own growth but also distorting global economic interactions in ways that may prove destabilizing.

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