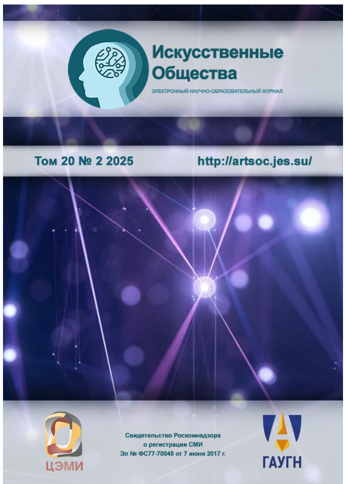

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Экономические теории и примеры высококачественных стратегий развития и торгового протекционизма в контексте международных экономических кризисов

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Аннотация

В последние годы международная рыночная конкуренция значительно усилилась, что было отмечено частыми вспышками торговых войн, финансовых войн, технологических войн и тарифных войн. В частности, недавняя международная тарифная война, инициированная Соединенными Штатами под видом политики взаимных тарифов, спровоцировала интенсивные потрясения в международных экономических отношениях. Это событие, редкое и значимое в историческом контексте, подчеркивает необходимость глубокого изучения базовых экономических законов. Опираясь на интегрированную аксиоматическую систему механики стоимости, которая включает классическую экономику, марксистскую экономику и неоклассическую экономику, это исследование использует теорему о том, что ускорение количества продукта обратно пропорционально качеству продукта, и оптимальную теорему для сложных функций стоимости в голоморфных условиях — на основе количества продукта, качества, трудовой стоимости и потребительной стоимости — для вывода уравнения общего равновесия высококачественного развития. Используя эту теоретическую основу, в исследовании анализируются различные формы тарифных войн, сравниваются плюсы и минусы различных вариантов принятия решений и изучаются соответствующие экономические законы, в конечном итоге стремясь выявить оптимальные решения.

Ключевые слова: механика стоимости, высококачественное развитие, уравнение равновесия, эквивалентная тарифная политика, анализ типичного случая, оптимальное решение

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1

1. Introduction

Recently, the United States abruptly imposed reciprocal tariffs on over 60 countries worldwide and subsequently adjusted its tariffs to 125% tariff on China and 10% on other countries. While this policy appears to be an accidental event in international economic competition, deeper analysis reveals it reflects underlying economic laws. The U.S. tariff policy is a manifestation of rising trade protectionism amid the global overcapacity crisis since the 21st century. Ultimately, all trade wars, financial wars, tech wars, and tariff wars share a common objective: to compete for international market share.

2 In contemporary economic research on foreign economic policies, the primary focus is to analyze specific international economic scenarios according to the law of the jungle law and the principles of game theory, with the aim of identifying strategies that enable countries to out-compete their rivals and maximize national interests. Given the dominance of capitalist countries in the 21st-century global economy, this approach is understandable, and it is inevitable that nations will prioritize their own interests.

3 However, the global economic system of the 21st century is an objective entity governed by unique economic laws that are mandatory and independent of human will. Violating these laws inevitably leads to adverse consequences, while adhering to them is essential for achieving optimal outcomes. Thus, focusing solely on maximizing individual benefits in localized strategic interactions is a superficial approach. Instead,

economic research should prioritize understanding objective economic laws and developing methods for global optimization. As emphasized, humanity is a community with a shared future[1]. Only through global optimization can individuals truly maximize their potential. This implies that if international market equilibrium could be achieved without overcapacity, the need for cutthroat competition and zero-sum games in the international market would be eliminated.

4 Guided by the principles outlined above, this paper focuses on China's high-quality development strategy and recent U.S. reciprocal tariffs to explore the economic behaviors of countries engaging in strategic interactions. Specifically, it investigates the impacts on future economic development of the interactions between free trade and multilateralism advocates, such as Russia and China, and trade protectionist and hegemonistic nations, led by the U.S. The main objective is to derive relevant theorems from a scientific economic theory framework, based on fundamental axiomatic assumptions, to explain related economic phenomena. This includes identifying the theoretical basis for conclusions on high-quality development, revealing the causes of cyclical economic crises, and exploring scientific methods and strategies to eliminate these crises that have long plagued human society since the Industrial Revolution and to ensure sustainable and stable global economic growth.

5 In recent years, economists from China and Russia, including[2], have made progress in mathematical political economy by adopting a scientific theoretical paradigm. They developed a mathematical model system called Value Mechanics, based on the classical theory of value from Marx's Capital – which posits that labor determines value and creates surplus value – and the analogy of economics to Newtonian mechanics proposed by[3,4,5,6,7]. From this axiomatic framework, they derived important theorems, including the Stalin-Mao-Xi Social Value Computability Theorem (referred to as the Value Computability Theorem[8]) for calculating social wealth value based on the fundamental economic laws of public ownership economies and the High-Quality Development Equilibrium Theorem.

6 Leveraging the theoretical achievements above, Chinese and Russian scholars[9] have developed a Social Economic Dynamics (SED) model using Agent-Based Modeling (ABM) to simulate the global economy. By integrating deductive AI techniques based on value mechanics with complex system simulations on the Tianhe-2 supercomputer, the SED model can simulate scenarios involving multiple countries, administrative levels, industries, enterprises, and tens of thousands of residents. It also supports simulation-based decision-making for governments, institutions, and individuals, effectively functioning as the "central nervous system" of a global economic system.

7 Specifically, the existing SED model is a sophisticated AI decision tree capable of performing intelligent calculations at the scale of 2^{4600}. It processes a 4600-layer deep binary decision tree, covering a vast number of path choices, making it well-suited for optimizing complex scenarios and game-theoretic decision-making. Given sufficient hardware and data resources, it can rapidly segment the global economic system into tens of millions of unique economic scenarios. It then identifies scenarios matching user needs for simulation-based decision-making, selecting the most optimized decision

schemes from tens of thousands of options. This process enables scientifically informed, AI-driven decision-making within the complex global economic system.

8 To date, the SED model has been applied in several key projects. These include analyzing the impact of China's 4-trillion-yuan fiscal investment during the international financial crisis, researching development strategies for China's strategic emerging industries, and forecasting and making decisions on the national economy of Guangdong Province in 2013. Additionally, simulations have been conducted on the Sino-US trade war, economic decoupling between China and Russia from Western developed countries, and mixed warfare scenarios[10,11,12,13,14,15].

9 In this paper, we build on the theoretical and ABM modeling research to explore the relationship between high-quality development strategy and the classical theory of value, and their application to guide real-world economic practices. Specifically, we argue that high-quality development strategies can fundamentally eliminate cyclical economic crises. Therefore, based on the general equilibrium theory of high-quality development, we aim to identify methods for sustainable and stable economic development and provide a scientific basis for sound macroeconomic policymaking.

10

2. Value Mechanics and High-quality Development Equilibrium

Since the Industrial Revolution, cyclical economic crises have posed a significant barrier to human social development. Following the Marginalist Revolution, various economic schools, such as the Chicago School's liberal approach and Keynesianism's quantitative easing and consumption stimulus, have proposed solutions to eliminate these crises, yet none have been particularly effective. However, we believe that the high-quality development strategy recently proposed by the Chinese government offers a promising solution to addressing cyclical economic crises. This means that there is an optimal operating rule for the human socio-economic system. Understanding this general economic law can prevent cyclical economic crises. This law is embodied in the High-Quality Development Equilibrium equation (referred to as the HQDE equation) and its corresponding theorem. Next, we will analyze the theoretical basis, logical relationships, and proof process of these conclusions.

11 Drawing on the qualitative economic principles within Marx's theory of capital and the research methods of mature natural sciences (physics), Wu[16] established a basic axiom system of five axioms (referred to as Value Mechanics):

12 **Axiom 1**: Natural wealth that can be obtained without labor has no value[17]. This is analogous to Newton's first law and defines the concept of inertial mass in an economic system.

13 **Axiom 2**: Value depends on the force of labor, specifically the amount of labor expended in the production process[18]. Particularly, the acceleration due to force of labor is inversely proportional to its mass (quality), that is, producing the same quantity of high-quality products will require more force of labor. This is analogous to Newton's second law.

14 **Axiom 3**: The force of labor expended in producing a given value is equal to the force of labor compensated in consuming that value[19], analogous to Newton's third law.

15 **Axiom 4**: Humans possess an innate ingenuity for improving dexterity and skill in the application of labor[20]. This implies a gravitational potential energy acceleration due to force of labor, analogous to the law of universal gravitation.

16 **Axiom 5**: The demand for any product of constant quality by any individual has an equilibrium point[21]. This is analogous to the law of conservation of energy.

17 From these axioms, the following conclusions can be drawn:

1. In the economic system of any country, the commodity space can be regarded as a 2 n -dimensional vector space $R^{2n} = Q^n \times M^n$, where Q^n and M^n represent the quantity and quality of commodities, respectively. Commodity vectors in this space (analogous to particles in a mechanical system) undergo displacement under human labor, generating the value of n types of commodities. The value of each commodity is expressed as a complex function[22], with quantity and quality as independent variables and labor value and the use value as dependent functions. The function's extremum under full holomorphism represents the maximum commodity value. The unit value of commodities determines their exchange value, and multiplying this exchange value by the flow of money yields the commodity price[23],[24]. Specifically, the realization of commodity value is governed by the law of value[25]: when supply meets demand, price equals value; when supply exceeds demand, price is higher than value; when supply falls short of demand, price is lower than value. Capital's pursuit of profit maximization drives prices toward their value.

18 1. Countries vary in their natural resource endowments and comparative advantages, primarily due to differences in the inertial quality of their economic systems. When engaging in international trade based on equivalent exchange, trade surpluses and deficits, and currency exchange rate differences inevitably arise and interact. These international economic relations can be reasonably represented mathematically through analogies to Galilean transformations.

19 (3) In a global economic system with a constant population, long-term production of traditional products inevitably leads to overcapacity. This can be mitigated by improving product quality.

20

2.1 Equation of High-Quality Development Equilibrium

Based on the theoretical conclusions above, specifically Axioms 1, 2, 4 and 5 of Value Mechanics, let $F(t)$ denote labor productivity, $M(t)$ product quality, $B(t)$ market demand, $Q(t)$ product quantity, r_f the growth rate of labor productivity[26], r_m the growth rate of product quality, and r_b the growth rate of market demand for product quantity. The equation for high-quality development Equilibrium is

21 $$r_f = r_b \frac{B(t)}{Q(t)} + r_m \frac{M(t)}{Q(t)} \quad (1)$$

22 According to the system of Capital and corresponding mathematical theories, the value of commodities is mathematically a Euclidean metric space[27]. If a function's domain is a bounded closed set in this space and the function is continuous, a critical point solution must exist. Moreover, if the objective function and feasible region are strongly convex, this solution is unique. Given that the domain of the HQDE equation is closed, it is compact. Thus, by Weierstrass's theorem, the equation has a unique critical point solution[28].

2.2 Proof of High-Quality Development Equilibrium

2.2.1 Function Construction and Domain Definition

23 Rewrite the equilibrium equation in functional form:

24 $$g(r_f, r_b, r_m) = r_f - r_b \cdot \frac{B(t)}{Q(t)} + r_m \cdot \frac{M(t)}{Q(t)}$$

25 **Domain**: Assume that the parameter ranges satisfy the physical constraints of the economic system:

26 $$r_f \in 0, r_f^{\max}, \ r_b \in 0, r_b^{\max}, \ r_m \in 0, r_m^{\max},$$

27 where $r_f^{\max}$, $r_b^{\max}$, $r_m^{\max}$ are the technically achievable upper limits of the growth rates (e.g., 20%).

28 The domain is a bounded closed set: Parameters vary continuously within the intervals, and the boundaries contain the limit points.

29 **2.2.2 Proof of Continuity** Variable continuity:

- $Q(t) = Q_0 e^{r_f t}$, $M(t) = M_0 e^{r_m t}$, $B(t) = B_0 e^{r_b t}$ are exponential functions and are continuously differentiable with respect to the parameters r_f , r_b , r_m .
- The function $g(r_f, r_b, r_m)$ is composed of continuous functions, hence it is continuous overall.

30 **2.2.3 Existence of Extremum (Weierstrass Theorem)**

- Theorem: A continuous function defined on a compact set (bounded closed set) must have a maximum and a minimum.
- Conclusion: The function $g(r_f, r_b, r_m)$ is continuous within the domain, and the domain is a compact set. Thus, there must be an extremum solution, meaning the economic system can converge to a certain equilibrium state.

31 The HQDE equation can guide international economic practices across different countries. In this section, we apply this equation to analyze cases of international technological monopolies and trade protectionism, including U.S. reciprocal tariff policies. We will assess the outcomes of various tariff strategies, compare decision-making options, suggest ways to achieve global optimization and mutual benefits in international economic competition, and emphasize the importance of adhering to objective economic laws.

3. Case Study

32

Case 3.1: Economic Impact of Chip Technology Blockades

For years, developed countries like the U.S. have pursued technological hegemony to maintain their tech edge and monopolize excess profits. Recently, they have imposed tech blockades and advanced product embargoes on China in the chip industry. This strategy contravenes the high-quality development equilibrium theorem, reducing societal wealth and harming others without self-benefit. This case uses the HQDE equation to assess the economic impact of the U.S. chip technology war, verifying these conclusions.

33 **3.1.1 Parameter Settings and Assumptions**

(1) Moore's Law and Technological Parameters

34 **Chip Quality Improvement**: If the density of transistors doubles every two years (Moore's Law), corresponding to an annual quality growth rate r_m =41.42% (calculation: $(2^{1/2} - 1) \times 100\%$).

35 **Technology Diffusion Speed**: The speed at which chip technology permeates various industries is an annual increase of 10% in automation rate (Source: Boston Consulting Group).

36 **(2) Scenario Design**

Scenario 1: The U.S. Chip Technology Blockade

37 Parameters setting for the impact of the U.S. technology blockade on China's chip industry are shown in the table below:

38 Table 3.1.1 Parameter Setting (2023-2030)

Parameter	**U.S. (Monopoly)**	**China (Restricted)**	**Rest of the World**
Initial Capacity Q_0	1000 million (high-end chips)	500 million (mid-low end chips)	800 million
Productivity r_f	5% (high technical barriers)	3% (restricted technology access)	4%
Quality M_0	100 (5nm process)	60 (28nm process)	80 (14nm process)
Quality growth rate r_m	2% (slow technology iteration)	4% (accelerated independent innovation)	3%
Demand growth rate r_b	Global demand r_b =6%	Domestic demand r_b =10%	Global demand r_b =6%

39 **Scenario 2: Application of Chinese Chip Technology** Select key industries like semiconductor, automotive, electronics manufacturing, and medical equipment. Sets initial parameters for each industry (2023), and estimate changes after the application of chip technology:

40 Table 3.1.2 Industry Classification and Initial Parameters (2023) Unit: trillion dollars

Industry	**Initial Capacity** P_0	**Initial Quality (index)** Q_0	Demand Growth Rate r_b	**Excess Capacity Rate**
Semiconductor	0.6	100 (benchmark)	8%	15%

Automotive	3.2	60	3%	20%
Electronics Manufacturing	2.1	70	5%	25%
Medical Equipment	0.9	50	6%	18%

41 **3.1.2 Application of HQDE equation** Objective: To reduce the excess capacity rate to 0% by increasing r_m (quality growth driven by chip technology) and r_f (productivity growth driven by automation) through the HQDE equation.

42 **(1) Calculation of Chip Technology Blockades (2030)**

43 U.S. (2030):

44 $Q(t) = 1000 \cdot e^{0.05 \cdot 7} \approx 1419$ million chips,

45 $M(t) = 100 \cdot e^{0.02 \cdot 7} \approx 115$,

46 Global demand: $B(t) = 1500 \cdot e^{0.06 \cdot 7} \approx 2283$ million chips

47 Right-hand side (RHS) of the HQDE equation:

48 $6\% \cdot \frac{2283}{1419} + 2\% \cdot \frac{115}{1419} \approx 9.65\% + 0.16\% = 9.81\%$

49 Left-hand side (LHS):

50 $r_f = 5\% < 9.81\%$,

51 Excess capacity rate:

52 $\Delta = 5\% - 9.81\% = -4.81\%$ (shortage mitigated by high prices suppressing demand).

53 **China (2030):**

54 $Q(t) = 500 \cdot e^{0.03 \cdot 7} \approx 616$ million chips,

55 $M(t) = 60 \cdot e^{0.04 \cdot 7} \approx 79.3$,

56 Domestic demand: $B(t) = 500 \cdot e^{0.1 \cdot 7} \approx 1003$ million chips

57 RHS of the HQDE equation:

58 $10\% \cdot \frac{1003}{616} + 4\% \cdot \frac{79.3}{616} \approx 16.28\% + 0.52\% = 16.80\%$

59 LHS:

60 $r_f = 3\% < 16.80\%$

61 Excess capacity rate:

62 $\Delta = 3\% - 16.80\% = -13.80\%$ (severe reliance on imports to fill the gap).

63 **(2) Calculation after Chip Technology Application (2030)**

64 Quality Improvement: For each industry, quality $M(t) = M_0 e^{r_m t}$, taking $t = 7$ years (2023-2030):

65 Semiconductor: $M = 100 \cdot e^{0.4142 \cdot 7} \approx 1817$

66 Automotive: $M = 60 \cdot e^{2.9} \approx 1090$

67 Electronics Manufacturing: $M = 70 \cdot e^{2.9} \approx 1272$

68 Medical Equipment: $M = 50 \cdot e^{2.9} \approx 909$

69 Capacity Adjustment: Productivity improvement through automation r_f =15%, capacity $Q(t) = Q_0 e^{r_f t}$.

70 Equilibrium Condition Verification: Take the automotive industry as an example (2030):

71 $Q = 3.2 \cdot e^{0.15 \cdot 7} \approx 3.2 \cdot 2.86 = 9.14$ trillion dollars

72 $B(t) = 3.2 \cdot e^{0.03 \cdot 7} \approx 3.2 \cdot 1.23 = 3.95$ trillion dollars

73 RHS of the HQDE equation:

74 $$r_b \cdot \frac{B}{Q} + r_m \cdot \frac{M}{Q} = 3\% \cdot \frac{3.95}{9.14} + 41.42\% \cdot \frac{1090}{9.14} \approx 1.30\% + 4940\% = 4941.30\%$$

75 LHS:

76 $r_f = 15\%$

77 Since LHS=15% is much lower than RHS=4941.30%, excess capacity needs to be reduced to achieve balance:

78 Excess capacity rate:

79 $$\Delta = \frac{r_f \text{ - RHS}}{r_f} = \frac{15\% \text{ - } 50.27\%}{15\%} \approx \text{ - } 328.42 \text{ (need to be eliminated)}$$

80 In practice, balance is achieved by increasing demand $B(t)$ (due to quality improvement) and eliminating low-end capacity.

81 Value Calculation of High-Quality Products:

82 Value Increment: For every doubling of quality, the unit price of the product increases by 30% (Source: Intel chip pricing).

83 Automotive Industry Quality Improvement: 18 times (from 60 to 1090), and the unit price increase $30\% \times \log_2(18) \approx 30\% \times 4.17 = 125.1\%$.

84 Value of High-Quality Products: $9.14 \times 125.1\% = 11.43$ trillion U.S. dollars.

85 **Total Value Gain Across Industries (2030)**

Table 3.1.3 shows the total value gains for different industries after implementing high-quality development strategies.

86 Table 3.1.3 Total Value Gain Across Industries Unit: trillion dollars

Industry	**Traditional Output value**	**Value Added of High Quality Products**	**Total Value Gain**
Semiconductor	1.71	+240%	4.1
Automotive	9.14	+125%	11.43

Electronics Manufacturing	6.0	+180%	10.8
Medical Equipment	2.57	+200%	5.14
Total	**19.42**	—	**31.47**

87 **3.1.3 Comparison of Monopoly Losses Caused by the Technology War (1) The U.S. Chip Technology Blockades** China's Direct Losses: Shortage volume of 1003 - 616 = 387 million chips, at a unit price of $5, annual loss $1935 million, cumulative loss of $13.55 billion over 7 years. Technology catch-up cost: Additional R&D investment of $20 billion annually → $140 billion over 7 years.

88 U.S. Monopoly Costs: Global consumer surplus loss: Chip price premium of 30%, global annual demand 2283 million chips → annual loss 2283×30%×5=3424.5 million dollars, cumulative loss $23.97 billion over 7 years.

89 Total Global Loss: China's losses + U.S. monopoly losses =13.55+140+23.97=177.52 billion dollars.

90 **(2) Application of Chinese Chip Technology** Direct Loss (Cumulative from 2023-2030): Global Chip Trade Reduction: U.S. export controls on China cause a 12% shrinkage in the global chip market (SEMI data), resulting in a loss of $72 billion. Redundant Construction Costs: Both the U.S. and China are investing in independent supply chains: $1.0 trillion for the U.S. and $1.7 trillion for China (Boston Consulting Group). Technology Lag Costs: A 20% slowdown in global innovation, dragging down the GDP growth rate by 0.3% per year → cumulative loss of $2.31 trillion (based on a global GDP of 110 trillion).

91 Indirect Losses: Capacity Utilization Decline: The global semiconductor capacity idleness rate rises from 15% to 25%, with an annual loss of $70.59 billion → $494.13 billion over 7 years. Consumer Surplus Loss: A 30% increase in chip prices, with an annual loss of $180 billion → $1.26 trillion over 7 years.

92 **Total Losses:** Table 3.1.4 shows the different types of losses measured because of the technology war.

93 Table 3.1.4 Types of Losses by Technology Wars Unit: billion dollars

Type of Loss	**Amount**
Trade Reduction	72
Redundant Construction (Average)	1350
Technology Lag	2310
Capacity Idle	494
Consumer Surplus Loss	1260
Total	**5486**

94 **3.1.4 Key Conclusions and Policy Implications** The mathematical proof of the equilibrium equation ensures that solutions exist within a reasonable parameter range, providing theoretical support for policymaking. Governments can achieve equilibrium by regulating r_b (to simulate demand) and r_m (for technological upgrading).

95 **Scenario 1**: The U.S. chip technology blockade has caused a global cumulative loss of over $175 billion, with China facing a direct cost of nearly $150 billion; by improving r_m (e.g., through domestic 7nm breakthrough), China can reduce losses by over 50%.

96 Policy Implications: For China, it is essential to accelerate technological breakthroughs (to improve r_m) and expand the domestic market (to boost r_b). On a global scale, it is crucial to oppose technological monopolies and optimize the ratio $B(t) / Q(t)$ through international cooperation. It should be noted that while actual policies require dynamic parameter calibration, the model framework reveals the core logic of technological competition and market balance.

97 **Scenario 2**: Economic Equilibrium Gains Driven by Chip Technology: High-quality product value of $31.47 trillion per year in 2030, with a cumulative total of $220.29 trillion over 7 years (assuming linear growth).

98 Monopoly Losses from the Technology War: Cumulative losses of $5.486 trillion over 7 years, with long-term innovation suppression.

99 Net Welfare Difference: The technology open path creates $215 trillion more value than the technology war path (220.29-5.486).

100 Policy Implications: Technological Openness: Enhance r_m and r_b through global cooperation to avoid redundant construction. Dynamic Adjustment: The elimination of low-end capacity should be accompanied by social security measures (such as retraining) to reduce transition friction. (Note: The above figures are based on idealized assumptions of technological diffusion. Geopolitical friction and technological bottlenecks should be considered. However, the model reveals the core logic of the "technology-economic" balance.)

101

Case 3.2: Economic Impact of Western Countries' 5G Technology Embargo on China

China's 5G technology, which has reached an internationally leading level, has disrupted the technological monopoly held by Western developed countries. In response, these countries have adopted import blockades, barring the overseas application of Chinese 5G technology. This strategy violates objective economic laws and diminishes societal wealth. This case uses the HQDE equation to analyze and prove these conclusions.

102 **3.2.1 Parameter Settings and Assumptions**

(1) Technology Development Path

103 Moore's Law Analogy: If the performance of China's 5G technology (e.g., spectral efficiency, latency and delay) doubles every two years, corresponding to an annual quality growth rate r_m =41.42% (calculation: $2^{1/2} - 1$).

104 No Blockade Scenario: China's 5G technology will freely penetrate the global market, driving digital transformation across industries.

105 Blockade Scenario: Western countries ban Chinese equipment, forcing China to focus on its domestic market, with limited technological spillover.

106 **(2) Key Parameters (2024-2030)**

Table 3.2.1 shows the key parameters of 5G market share, quality growth rate, demand growth rate and initial market size in China and Western countries under different scenarios set according to the needs of case studies.

107 Table 3.2.1 Parameter Settings for Different Scenarios

Parameter	**No Blockade (China)**	**Blockade (China)**	**Western Countries (Post-Blockade)**
Market Share	Global 60% (2030)	Global 30% (2030)	Self-built 5G accounts for 70%
Quality Growth Rate r_m	40% (Moore's Law)	25% (Technological Isolation)	15% (High Cost Constraints)
Demand Growth Rate r_b	Global 8%	Domestic 12% (Domestic Demand Driven)	Global 6% (High Prices Suppressing Demand)
Initial Market Size	Global 5G Equipment Market $50 billion in 2024	China's Domestic 5G Market $30 billion	Western Self-built Market $20 billion

108 **3.2.2. Application of the Equilibrium Equation** Objective: To achieve dynamic balance between capacity $Q(t)$ and demand $B(t)$ by improving quality $M(t)$ and demand through the HQDE equation.

109 **(1) No Blockade Scenario (2030)**

China's 5G Equipment Output:

110 $Q = 500 \times 60\% \times (1 + 8\%)^6 \approx 500 \times 0.6 \times 1.59 = 476.1 = 47.61$ billion dollars.

111 Quality Improvement:

112 $M = 100 \times (1 + 40\%)^6 \approx 100 \times 7.53 = 753$ (benchmark value 100 for the year 2024).

113 Equilibrium Verification:

114 $r_f = 8\% \cdot \frac{500 \times 1.59}{476.1} + 40\% \cdot \frac{753}{476.1} = \approx 13.33\% + 63.59\% = 76.59\%$

115 Actual productivity r_f needs to match 76.59%, achieved through automation and economies of scale, with no excess capacity.

116 **(2) Blockage Scenario (2030)**

China's Domestic Output:

117 $Q = 300 \times (1 + 12\%)^6 = 300 \times 1.97 = 592.2 = 59.22$ billion dollars.

118 Quality Improvement:

119 $M = 100 \times (1 + 25\%)^6 \approx 100 \times 3.81 = 381$

120 Equilibrium Verification:

121 $r_f = 12\% \cdot \frac{300 \times 1.97}{592.2} + 25\% \cdot \frac{381}{592.2} \approx 12\% + 16.08\% = 28.08\%$

122 China's actual r_f is around 25%~30%, close to equilibrium, but significant global technology spillover losses.

123 **3.2.3 Economic Loss Calculation (Cumulative from 2024-2030)**
(1) Direct Costs of Western Blockade

Table 3.2.2 shows the direct cost estimates of the Western blockade on China's 5G technology.

124 Table 3.2.2 Direct Costs of Western Blockade

Loss Item	**Calculation Logic**	**Total Loss Over 7 years**
Reduced Chinese Export Revenue	Loss of 30% global market share, annual loss $15 billion	$105 billion
Increased Western Construction Costs	30% higher cost due to ban on Chinese equipment, additional annual expenditure $60 billion	$420 billion
Global Demand Suppression	High prices delay global 5G deployment by 2 years, annual GDP loss 0.2%	$1.54 trillion (Global GDP $110 trillion ×0.2×7)

125 **(2) Long-Term Costs of Technological Isolation**

Table 3.2.3 shows the long-term costs of technological isolation, with both China and the world suffering some losses.

126 Table 3.2.3 Long-Term Costs of Technological Isolation

Loss Item	**Calculation Logic**	**Total Loss Over 7 years**
Reduced Chinese Quality Growth Rate	drops from 40% to 25%, slowing technological gap closure, loss of potential patent revenue $10 billion	$70 billion
Global Innovation Lag	5G applications (e.g., autonomous driving) delayed by 3 years, dragging global productivity by 0.3% annually	$2.31 trillion

127 **(3) Total Loss Comparison**

Table 3.2.4 shows the different types of losses measured as a result of Western blockades.

128 Table 3.2.4 Total Losses of 5G Blockade Unit: trillion dollars

Scenario	**Direct Losses**	**Indirect Losses**	**Total**
No Blockade (Ideal)	—	—	Technology-driven Gains
Western Blockade	0.07+0.042=0.112	0.07+2.31=2.38	**0.112+2.38=2.492**

129 **3.2.4 Key Conclusions and Policy Implications**

(1) Key Conclusions: Gains in No Blockade Scenario: China's 5G technology drives global digital economic gains of $1.3 trillion per year by 2030 (PwC estimate), cumulatively $8.4 trillion over 7 years. Losses in Blockade Scenario: Cumulative losses of $2.492 trillion over 7 years, delaying the global technological revolution. Net Welfare Difference: The open path creates $5.9 trillion more value than the blockade path ($8.4-$2.492).

130 (2) Policy Implications: Technology Openness: Global cooperation can maximize r_m and r_b , avoiding the "lose-lose" situation of redundant construction. Countermeasures Against Blockade: China needs to accelerate 6G R&D ($r_m \uparrow$), breaking technological barriers with lower costs and higher performance.

131 Note: Actual losses are subject to policy adjustments and technological breakthroughs, but the model reveals the economic irrationality of the "blockade-isolation" path. Data sources: ABI Research (5G market), Boston Consulting Group (construction costs), World Bank (GDP impact).

132 **Case 3.3: Economic Impact of U.S. Reciprocal Tariff Trade War**

In the international economic system, differences in natural resources and technological development among countries result in varying values and prices. Although international trade can achieve complementary strengths and mutual for the same goods or services. While international trade can facilitate complementary advantages and mutual benefits, it can also lead to imbalances, such as trade deficits or surpluses. This is particularly evident during cyclical economic crises, when the global economy faces severe overcapacity and trade imbalances. Achieving an optimal global trade balance thus requires careful study. This case study examines the recent U.S. policy of reciprocal tariffs, comparing the advantages and disadvantages of two strategies: free flow of capital and technology versus monopoly friction.

133 **3.3.1 Parameter Settings and Assumptions**

Assume that there are two countries, Country A (resource-based) and Country B (technology-based), producing two goods, oil (Good 1) and chips (Good 2), with the following parameters:

134 Table 3.3.1 shows the parameter settings for comparative advantages of different countries. For example, Country A, with abundant natural resources, excels in oil production, while Country B, with its skilled labor force, is highly efficient in electronic product production. According to Axiom 4, Country A's oil has a higher "inertial quality acceleration," whereas Country B's electronics benefit more from repeated labor in enhancing dexterity and proficiency.

135 Table 3.3.1 Comparative Advantage Parameters of Countries

Indicator	**Country A (Oil)**	**Country B (Chips)**
Comparative Advantage in Natural Resource (Inertial Quality Acceleration m)	High (m_1 =100)	Low (m_1 =20)
Effect of enhancing dexterity and proficiency (Productivity r_f)	Low (r_f =3%)	High (r_f =8%)
Initial Capacity Q_0	10 million barrels	10 million units
Unit Labor Value w	50 dollars/barrel (low added value)	500 dollars/unit (high value-added)

136 International Trade Conditions: (1) Free Trade Policy: Free flow of capital and technology, division of labor according to comparative advantage, no tariffs. (2) Reciprocal Tariff Policy: Both countries impose a 20% tariff on imported goods, suppressing comparative advantages.

137 **3.3.2 Comparison of Economic Impacts and Analysis of Reasons**

(1) Economic Impacts of Free Trade Policy

Under the international division of labor and trade balance:

138 **Country A**: Focuses on oil production, increasing capacity to 15 million barrels (amplified comparative advantage), exporting 8 million barrels to Country B.

139 Gains:

- Oil export revenue: $8 \times 10^6 \times 50 \times (1 + 3\%)^5$ = 464 million dollars;
- Chip import cost: $12 \times 10^6 \times 500 / (1 + 8\%)^5$ = 4083 million dollars;

- Net gain: 464 - 4083 = - 3621 million dollars (trade deficit, compensated by capital inflows).

140 **Country B**: Focuses on chip production, increasing capacity to 20 million units (technological spillover effect), exporting 12 million units to Country A.

141 Gains:

- Chip export revenue: $12 \times 10^6 \times 500 \times (1 + 8\%)^5$ = 8816 million dollars;
- Oil import cost: $8 \times 10^6 \times 50 / (1 + 3\%)^5$ = 345 million dollars;
- Net gain: 8816 - 345 = 8471 million dollars (trade surplus, capital outflow to Country A).

142 **Global**: Total wealth growth: $(15 \times 10^6 \times 50 + 20 \times 10^6 \times 500) \times 5\%$ annual growth rate = + 2688 million dollars (cumulative over 5 years).

143 **(2) Economic Impacts of Reciprocal Tariff Policy**

In the case of trade distortion and excess capacity:

144 **Country A**: Affected by the 20% tariff, oil exports drop to 4 million barrels, excess capacity rate , forced to reduce production.

145 Losses:

- Oil export revenue: $4 \times 10^6 \times 50 \times (1 + 3\%)^5$ = 232 million dollars;
- Chip import cost: $6 \times 10^6 \times 500 \times 1.2 / (1 + 8\%)^5$ = 2450 million dollars (including tariffs);
- Net loss: 232 - 2450 = - 2218 million dollars (widening deficit).

146 **Country B**: Chip exports drop to 6 million units, technological upgrading slows, quality growth rate drops from 5% to 3%.

147 Losses:

- Chip export revenue: $6 \times 10^6 \times 500 \times (1 + 8\%)^5$ = 4408 million dollars;
- Oil import cost: $4 \times 10^6 \times 50 \times 1.2 / (1 + 3\%)^5$ = 207 million dollars;
- Net gain: 4408 - 207 = 4201 million dollars (reduced surplus).

148 **Global**: Total wealth loss: $(8 \times 10^6 \times 50 + 12 \times 10^6 \times 500) \times 2\%$ decline = - 640 million dollars (cumulative over 5 years).

149 **(3) Comparison of Effects and Analysis of Reasons**

Table 3.3.2 compares the above calculation results, highlighting the differences between the two.

150 Table 3.3.2 Comparison of Economic Impacts of Two Policies

Indicator	**Free Trade Policy**	**Reciprocal Tariff Policy**	**Difference**
Global Wealth Appreciation	+2688 million dollars	-640 million dollars	3328 million dollars
Country A's Trade Deficit	-3621 million dollars (capital compensation)	-2218 million dollars (unsustainable)	Reduced deficit by 1403 million dollars

Country B's Trade Surplus	+8471 million dollars	+4201 million dollars	Reduced surplus by 4270 million dollars
Capacity Utilization Rate	95% (equilibrium)	75% (surplus)	**Decreased by 20%**

151 Analysis of Reasons:

152 Advantages of Free Trade:

1. Division of labor based on comparative advantage: Country A leverages its natural resource inertial mass, Country B leverages its technological proficiency, enhancing global productivity.
2. Capital flow compensates for deficits: Country A balances its trade deficit by attracting foreign investment (e.g., Country B investing in oil fields), achieving dynamic equilibrium.

153 Disadvantages of Reciprocal Tariffs:

154 1. Distorted price signals: Tariffs artificially inflate import costs, causing supply-demand imbalances (e.g., oil surplus in Country A, chip overstock in Country B).
2. Inhibited technological diffusion: Tariffs hinder technology flow, reducing Country B's r_m and slowing global innovation.
3. Local optimum trap: Countries forced into self-sufficiency, losing economies of scale, violating "energy conservation" (resource misallocation and waste).

155 3.3.3 Key conclusions and Policy Implications From the mathematical verification of the HQDE equation, it is clear that: under free trade, the equation is solvable; under tariff policy, LHS of the equation $r_b \downarrow$, $r_m \downarrow$, making r_f unmatchable, resulting in insoluble contradictions. (1) Conclusion: The choice of international trade policy is essentially a confrontation between "Newtonian mechanics" and "friction resistance". Only by reducing tariff friction and releasing market inertia can high-quality development equilibrium be achieved. (2) Policy Implications: Support Free Trade: Achieve global optimization through capital and technology flows, aligning with the "inertia-dexterity through labor-energy conservation" synergy of the HQDE theorem. Oppose Reciprocal Tariffs: Tariffs violate the axioms of value mechanics, leading to system entropy increase (efficiency loss), requiring multilateral agreements (e.g., Regional Comprehensive Economic Partnership, RCEP) to replace unilateral sanctions.

156

Case 3.4: Economic Impact of U.S. Reciprocal Tariffs on Over 60 Countries

If the United States unilaterally imposes reciprocal tariffs on more than 60 countries (i.e., levying tariffs on imported goods at the same rate as the tariffs imposed by the respective countries), this will trigger global trade frictions. Based on 2023 data and incorporating models from the WTO, World Bank, and IMF, we analyze its economic impacts.

157 **3.4.1 Parameter Settings and Assumptions**

(1) Trade Data:

- U.S. annual import total: $3.4 trillion (12% of global trade);

- Exports from the 60 affected countries to the U.S.: \$2.1 trillion (62% of U.S. imports).

(2) Tariff Rates:

- Average tariff rate increases from 2% to 20% (referencing the level of U.S. Section 301 tariffs on China).

(3) Elasticity Coefficients:

- Import demand price elasticity: -1.2 (medium to short term);
- Export supply elasticity: 0.8 (time needed for enterprises to adjust supply chains).

158 **3.4.2 Direct Economic Impacts**

(1) Trade Flow Changes:

- U.S. imports decrease: With a 20% tariff imposed by the 60 countries on U.S. exports, the U.S. annual exports of \$2.5 trillion are expected to decrease significantly

(2) GDP Impacts:

- U.S. GDP loss: Considering a trade multiplier effect of 1.5, the U.S. GDP is projected to decline.
- Global GDP loss: The chain reaction in the 60 countries leads to a global trade decrease of \$4.5 trillion, with the global GDP growth rate dropping by 1.8% (IMF model)

159 3.4.3 Imbalance of the HQDE equation (1) Parameter Changes: For the U.S.: Labor productivity $r_f \downarrow$ 2% (supply chain disruptions); Demand growth rate $r_b \downarrow$ 3% (inflation suppressing consumption); Quality growth rate $r_m \downarrow$ 1.5% (obstructed technical cooperation).

160 Globally:

161 Average $r_f \downarrow$ 1%, $r_b \downarrow$ 2%, $r_m \downarrow$ 1%.

162 (2) Equilibrium Verification: For the U.S.:

163 $0.03 - 0.02 = 0.04 - 0.03 \cdot \frac{B}{Q} + 0.05 - 0.015 \cdot \frac{M}{Q}$ ⇒ No solution (excess capacity rate Δ=4.5%).

164 Globally: Excess capacity rate rises from 2% to 6%, requiring coordinated production cuts or technological breakthroughs across multiple countries to restore equilibrium.

165 **3.4.5 Industry Chain and Consumer Impacts**

(1) Industry Chain Cost Increase:

- U.S. Manufacturing: A 20% increase in the cost of imported parts, with a 15% rise in costs for industries such as automotive and electronics.
- Global Supply Chain: Acceleration of regionalization trends, with Southeast Asia and Mexico taking on 30% of transferred production capacity, but with a 10% drop in efficiency.

(2) Consumer Inflation:

- In the U.S., CPI rises by 3-5 percentage points, increasing household annual expenditure by $3,000.
- Global inflation increases from 4% to 6%, with an additional 50 million people falling into poverty.

166 **3.4.6 Long-Term Structural Impacts**

(1) Technological Isolation:

- U.S. Semiconductor Exports: Restricted, prompting China and the European Union (EU) to accelerate independent innovation, reducing the technology gap by 40% within 5 years.
- Global Patent Cooperation: Decreased by 25%, slowing breakthroughs in AI and new energy fields.

(2) Trade Grouping:

- RCEP and EU Internal Trade: Increased by 15%, with the U.S. market share dropping by 8%.
- USD Settlement: Declines from 59% to 52%, with an increase in the share of the RMB and EUR.

167 **3.4.7 Policy Scenario Comparison**

Indicator	Reciprocal Tariff Policy	Free Trade Policy	Difference
U.S. GDP Growth Rate	-1.2%/year (cumulative -6% over 5 years)	+2.1%/year (cumulative +10.5% over 5 years)	**-16.5%**
Global Trade Volume	Decrease by 18% (loss of $9 trillion)	Increase by 24% (gain of $12 trillion)	**-21 trillion**
Inflation Rate	U.S. 6%, Global 5.5%	U.S. 2%, Global 3%	**+3.5%**
Technology Diffusion Speed	Decrease by 30%	**Increase by 20%**	**Innovation gap widens by 50%**

168 **3.4.8 Conclusions and Implications**

(1) Economic Costs: The U.S. reciprocal tariff policy will result in a cumulative loss of $15 trillion over 5 years, with a global loss of $30 trillion, far exceeding the short-term "protection" gains.

169 (2) High-Quality Development Path: Alternative Strategies: Coordinate standards through multilateral agreements (e.g., IPEF) to enhance quality ($r_m \uparrow$) rather than building walls; Open green technology and joint R&D in semiconductors to offset the suppression of r_f and r_b by tariffs.

170 (3) Policy Implications: Avoid Zero-Sum Games: Tariff wars have no winners; global collaboration is needed to maintain the WTO framework. Focus on Endogenous Growth: Invest in education, infrastructure, and R&D to enhance r_m and r_f instead of relying on trade barriers. Data Source: WTO Trade Statistics, IMF Global Economic Outlook, Peterson Institute for International Economics (PIIE) tariff effect model.

171

Case 3.5: Economic Impact Under Differentiated Tariff Policies for the U.S., China, and Other Countries

3.5.1 Parameter Settings and Assumptions

If the U.S. imposes a 125% tariff on China, China imposes an 84% tariff on the U.S., and the U.S. imposes a 10% tariff on 60 other countries. Based on the HQDE equation, the following parameters are set:

172

Country/Region	Productivity Growth Rate r_f	Quality Growth Rate r_m	Demand Growth Rate r_b	**Initial Capacity** Q_0
U.S.	2.5%	1.5%	1.8%	100 (benchmark)
China	5.0%	6.0%	5.5%	120
Other Countries	3.0%	3.5%	4.0%	80

173 **3.5.2 Direct Impacts on the U.S.** (1) Rising Import Costs and Inflation Pressure: Chinese Goods Prices: Due to the 125% tariff, prices at the consumer level increase by 80-100% (with some cost absorption by Chinese exporters), suppressing consumer demand ($r_b \downarrow$ 0.5%).

174 Goods from Other Countries: The 10% tariff leads to a 6-8% increase in import costs, raising the CPI by approximately 0.8%. (2) Export Setbacks:

- Exports to China: China's 84% tariff reduces U.S. exports of cars, soybeans, etc., by 50% (annual loss of $60 billion).
- Exports to Other Countries: Retaliatory tariffs cut U.S. exports by 8% (annual loss of $40 billion).

1. Imbalance of the HQDE equation:

175 $r_f = 2.5\% < r_b \cdot \frac{B}{Q} + r_m \cdot \frac{M}{Q} = 1.3\% \cdot 0.9 + 1.5\% \cdot 0.8 = 2.3\% \Rightarrow \Delta = \pm 0.2\%$ (mild surplus)

176 Conclusion: Short-term excess capacity surplus is manageable, but long-term technological upgrading slows ($r_m \downarrow$ 0.3%), threatening competitiveness.

177 **3.5.3 Impacts on China and Adjustments** (1) Export Cliff and Demand Transformation: Exports to the U.S.: The 125% tariff cuts exports by 60% (annual loss of $450 billion), forcing capacity to shift to domestic demand ($B(t) \uparrow$ 2%). (2) Quality Upgrading: Policy subsidies boost $r_m \uparrow$ 1.5%, and the share of green manufacturing rises from 25% to 35%. (3) Equilibrium Restoration:

178 $r_f = 5.0\% \approx r_b \cdot \frac{B}{Q} + r_m \cdot \frac{M}{Q} = 5.5\% \cdot 1.02 + 7.5\% \cdot 1.1 = 5.6\% \Rightarrow \Delta = -0.6\%$ (Slight shortage)

179 Conclusion: Through quality upgrading and demand shifting, China maintains dynamic equilibrium but needs to continuously invest in technology ($r_m \geq$ 7%).

180 **3.5.4 Opportunities and Risks for Other Countries**

(1) Alternative Trade Growth:

- Filling the U.S. Market: Exports from 60 countries to the U.S. increase by 15% (annual gain of $180 billion) but face a 10% tariff.
- Expanding China Cooperation: China's import demand shifts to Southeast Asia and the EU, with RCEP trade volume growing by 12%.

(2) Equation Optimization:

181 $$r_f = 3.0\% < r_b \cdot \frac{B}{Q} + r_m \cdot \frac{M}{Q} = 4.0\% \cdot 1.1 + 3.5\% \cdot 1.05 = 4.4\% \ \Rightarrow \ \Delta \ = \ \text{-1.4\%}$$ (need to expand production)

182 Conclusion: Other countries need to increase capacity ($Q(t) \uparrow$ 10%) to meet new demand, but face supply chain bottlenecks ($r_f \downarrow$ 0.5%).

183 3.5.5 Comparison of Economic Impacts

Indicator	**U.S.**	**China**	**Other Countries**
GDP Growth Rate Change	-1.2% (annual loss of $300 billion)	+4.5% (an annual gain of $1.1 trillion)	+0.8% (annual gain of $200 billion)
Inflation Rate	+3.2% (CPI 6.5%)	+1.5% (CPI 3.0%)	+2.0% (CPI 5.0%)
Capacity Utilization Rate	78% (surplus)	92% (equilibrium)	85% (need to expand production)
Technological Upgrading Pressure	Low ($r_m \downarrow$)	High ($r_m \uparrow$)	Medium (dependent on external cooperation)

184 3.5.6 Long-term Impacts and Policy Implications

U.S.:

- Risks: Technological isolation leads to innovation slowdown, with semiconductor share dropping from 42% to 30% in five years.
- Suggestion: Exempt key products from tariffs (e.g., pharmaceuticals, chip equipment) and restore technological cooperation.

185 China:

- Opportunities: The "Dual Circulation" strategy accelerates the maturation of the domestic market, with new energy exports replacing those to the U.S. and EU.
- Suggestion: Expand investment in ASEAN and the Middle East to offset tariff barriers in Europe and the U.S.

186 Other countries:

- Risks: Over-reliance on the U.S. and Chinese markets makes them vulnerable to geopolitical shocks.
- Suggestion: Deepen regional integration (e.g., African Free Trade Area) to diversify trade risks.

187 **3.5.7 Conclusions** Only through technology upgrading ($r_m \uparrow$) and demand adaptation ($B/Q \uparrow$) can dynamic equilibrium be achieved; tariff wars destroy global optimality. Under the differentiated tariff policies, the U.S. and China exhibit a "relative winner in a lose-lose" situation: China maintains growth through quality upgrading and domestic demand expansion but faces short-term pain; The U.S. suffers from protectionism, leading to inflation and a decline in competitiveness; Other countries benefit in the short term but need to build independent supply chains in the long term. Data Sources: World Bank trade database, IMF tariff effect model, China Customs, U.S. Department of Commerce.

188

3.6 Economic Impact of Differentiated Tariffs and Service Sanctions between the U.S. and China

In the international tariff war, using war to stop war is a prisoner's dilemma strategy in Nash equilibrium, leading to a non-cooperative Nash equilibrium. However, it violates objective economic laws. This case uses the HQDE equation to analyze and verify these conclusions.

189 **3.6.1 Parameter Settings and Assumptions**

If the U.S. imposes a 125% tariff on China, China imposes an 84% tariff on the U.S. and imposes $47 billions of surplus sanctions on the U.S. service sector (restricting financial, educational, and technological service exports). According to the HQDE equation, the following parameters (2024-2030) are set:

190

Country/Indicator	U.S.	China	Other countries
Productivity Growth Rate r_f	2.5% → 2.0% (supply chain friction)	5.0% → 5.5% (technological catch-up)	3.0% → 3.3% (substitution effect)
Quality Growth Rate r_m	1.5% to 1.2% (blocked innovation)	6.0% → 7.0% (import substitution)	3.5% to 3.8% (technology spillover)
Demand Growth Rate r_b	1.8% to 1.0% (inflation suppression)	5.5% → 6.2% (domestic demand expansion)	4.0% → 4.5% (market shift)
Initial Capacity Q_0	100 (benchmark)	120	80

191 **3.6.2 Economic Impact on the U.S.**

(1) Trade Imbalance:

- Increased Import Costs from China: The 125% tariff doubles the prices of Chinese consumer goods, reducing demand by 30%. U.S. retailers are forced to turn to Vietnam and Mexico, increasing costs by 15%.
- Export Setbacks: China's 84% tariff cuts U.S. exports of agricultural products and chips by 40%, resulting in an annual loss of $80 billion.

(2) Service Sanctions Impact:

- Education: China restricts student visas, reducing U.S. university revenue by $12 billion annually.
- Technology Services: Cloud computing and patent licensing are blocked, causing Silicon Valley firms to lose $20 billion.
- Finance: Chinese firms exit Wall Street, shrinking investment banking by $15 billion.

(3) Imbalance of the HQDE equation:

192 $2\% < (1.0\% \cdot 0.85 + 1.2\% \cdot 0.78) = 0.85\% + 0.94\% = 1.79\% \Rightarrow \Delta = \pm 0.21\%$ (Short-term surplus)

193 Excess capacity in low-end sectors (retail, low-end manufacturing), while high-tech sectors (AI, biopharma) slow down due to interrupted technology cooperation.

194 **3.6.3 China's Adjustments and Countermeasures**

(1) Export Substitution and Domestic Demand Expansion:

- U.S. Goods Exports: A 50% drop in electromechanical products, but 30% are transferred to Southeast Asia and the Middle East via the Belt and Road Initiative.
- Domestic Consumption: Policy stimulus boosts demand for new energy vehicles and green home appliances by 20%, offsetting the export gap.

(2) Service Sanctions Countermeasures:

- Domestic Substitution: Restricting U.S. cloud services (AWS, Azure) boosts Huawei Cloud and Alibaba Cloud market share to 65%.
- International Collaboration: Reaching a data compliance agreement with the EU attracts $30 billion in European technology investment.

(3) Equilibrium Optimization:

195 $5.5\% < (6.2\% \cdot 1.1 + 7.0\% \cdot 1.05) = 6.82\% + 7.35\% = 14.17\%$

196 $\Rightarrow$ Model weight adjustment needed

197 Adjustment: The service trade term $r_S \cdot \frac{S(t)}{Q(t)}$ is added to the HQDE equation, allowing for equilibrium after adjustment.

198 **3.6.4 Opportunities and Challenges in Other Countries**

(1) Supply Chain Substitution Benefits:

- Southeast Asia: Takes on $200 billion in low-end manufacturing orders from China but faces infrastructure bottlenecks (10% increase in logistics costs).
- Mexico: Exports to the U.S. increase by 25%, with automotive capacity utilization reaching 95%.

(2) Deepened Technology Cooperation:

- EU-ASEAN: Joint green technology R&D increases photovoltaic and battery capacity by 15%.
- India: Attracts U.S. tech outsourcing, boosting IT services by 12%, but faces talent outflows to Europe and the U.S.

(3) Equilibrium Verification:

199 $3.3\% < (4.5\% \cdot 1.05 + 3.8\% \cdot 1.02) = 4.73\% + 3.88\% = 8.61\%$

200 $\Rightarrow \Delta = -5.31\%$ (need to expand production)

201 Countermeasures: Expand production investment by $1.5 trillion, but debt rises to 75% of GDP.

202 **3.6.5 Comparison of Economic Impacts (2030)**

203

Indicator	**U.S.**	**China**	**Other Countries**
Cumulative GDP Change	-$3.6 trillion (annual -1.7%)	+$7 trillion (annual +4.8%)	+$6 trillion (annual +2.4%)
Inflation Rate	6.5% (shortage of goods)	3.2% (capacity adjustment)	4.8% (imported inflation)
Trade Dependence	Import /GDP 18% → 12%	Export / GDP 20% → 18%	Export / GDP 30% → 35%
Technology Autonomy Rate	Semiconductors 75% → 68%	Chip 28nm domestication rate 90%	Green technology patent share 40%

204 **3.6.6 Deep Mechanisms and Policy Implications**

(1) U.S. Structural Contradictions:

- Deindustrialization Trap: Tariff protection for low-end industries leads to high-tech losses (e.g., TSMC Arizona factory delays).
- Recommendations: Exempt critical material tariffs (e.g., rare earths, raw drugs) and restore technological cooperation.

(2) China's Dual Circulation Resilience:

- Risks: Real estate and local debt pressures constrain domestic demand, requiring $500 billion in liquidity via REITs and consumption vouchers.
- Opportunities: RCEP service trade agreements mitigate U.S. and EU blockades.

(3) Dependency Risks for Other Countries:

- Supply Chain Monoculture: Over-reliance on U.S.-China orders necessitates regional reserve systems (e.g., ASEAN food alliance).
- Recommendations: Promote the African Free Trade Area to diversify market risks.

205 **3.6.7 Conclusions** From the HQDE theorem, trade barriers alone cannot solve imbalances; dynamic equilibrium can only be achieved through $r_m \uparrow$ (quality) and $r_b \uparrow$ (demand). Differentiated tariffs and service sanctions will reshape the global economic tripod:

- U.S.: Short-term protectionism backfires, weakening long-term technological leadership.
- China: Maintains growth through domestic demand and technological substitution but must guard against financial risks.
- Other Countries: Gain substitution benefits but face increased debt and inflation pressures.

206 In summary, trade protectionism tends to act as a major barrier to the smooth progress of social economy. Although it can temporarily safeguard inefficient enterprises and mitigate unemployment during economic crises and periods of overcapacity, it may, in the long term, impede businesses from eliminating excess capacity through product quality enhancement — guided by the principle that "acceleration is inversely proportional to quality" — thereby undermining the sustainable development of the economy. Trade protectionism persists due to overcapacity and cyclical economic crises that have plagued society since the Industrial Revolution. As long as these crises exist, trade protectionism will remain. Conversely, resolving these crises would eliminate trade protectionism. Therefore, implementing economic strategies based on high-quality development equilibrium can ensure sustainable and stable growth of the globalized economy and eliminate both cyclical economic crises and trade protectionism. The five cases in this section all support this conclusion.

207

4. International Economic Prospects under Trade, Tech, and Tariff Wars

The current globalized economy is on the brink of its most severe cyclical economic crisis yet. In recent years, frequent trade, tech, financial, and tariff wars, as well as hybrid wars against Russia by Western developed countries amid the Russia-Ukraine conflict, have created significant uncertainty around the timing of economic crises. Analysis of high-quality development equilibrium under the critical point of global economic crisis involves multi-scenario simulations based on equilibrium shock and U.S. Treasury debt crisis. In this section, we explore the impacts of three scenarios – 10%, 25%, and 50% disruptions to the equilibrium of the HQDE equation – along with a credit crisis in U.S. Treasury bonds, on national economic systems.

208

4.1 Definition of Equilibrium Shocks

4.1.1 Assumption of External Shocks: External shocks (such as trade wars, geopolitical conflicts) lead to a decline in the "demand-quality composite contribution" on RHS of the HQDE equation, disrupting the original balance. These shocks are categorized by severity:

- Mild Shock (10%): A 10% decline in either demand or quality growth rate.
- Moderate Shock (25%): A 25% decline in either demand or quality growth rate.
- Severe Shock (50%): A 50% decline in either demand or quality growth rate.

209 **4.1.2 U.S. Treasury Bond Credit Crisis Scenario:**

- Soaring U.S. bond yields (e.g., 10-year Treasury rates exceeding 6%).
- Contraction of U.S. dollar liquidity, with global capital repatriation to the U.S.
- Depreciation of emerging market currencies and a surge in debt default risks.

210

4.2 Economic System Responses Under Three Shocks

Initial parameter settings (Benchmark Scenario):

211 r_f =5%, r_b =4%, r_m =3%, B/Q =0.8, M/Q =0.6

212 At this point, the HQDE equation holds:

213 $5\% = 4\% \cdot 0.8 + 3\% \cdot 0.6 = 3.2\% + 1.8\%$

214 **4.2.1 Mild Shock (10% Equilibrium Disruption)** Shock Manifestation: A 10% decline in demand growth rate (r_b =3.6%), or a 10% decline in quality growth rate (r_m =2.7%).

215 Equation Imbalance:

216 $5\% \neq 3.6\% \cdot 0.8 + 3\% \cdot 0.6 = 2.88\% + 1.8\% = 4.68\%$ ($\Delta = +0.32\%$)

217 Economic Consequences:

- Excess Capacity: A short-term surplus rate of 0.32%, necessitating production cuts or promotional activities to clear inventory.

- Policy Response: Minor interest rate cuts (e.g., 25 basis points) to stimulate demand, or subsidies for corporate R&D to boost r_m .

218 **4.2.2 Moderate Shock (25% Equilibrium Disruption)** Shock Manifestation: Simultaneous declines in both demand and quality (r_b =3.0%, r_m =2.25%).

219 Equation Imbalance:

220 $5\% \neq 3.0\% \cdot 0.8 + 2.25\% \cdot 0.6 = 2.4\% + 1.35\% = 3.75\% \ (\Delta = +1.25\%)$

221 Economic Consequences:

- Rising Unemployment: Manufacturing capacity utilization drops to 75%, increasing unemployment by 2-3%.
- Deflation Risk: A 5% decline in commodity prices, contracting corporate profits.
- Policy Response: Large-scale fiscal stimulus (e.g., 2% of GDP), targeted industrial upgrade loans.

222 **4.2.3 Severe Shock (50% Equilibrium Disruption)** Shock Manifestation: Demand collapse (r_b =2.0%) compounded by technological supply chain disruption (r_m =1.5%).

223 Equation Imbalance:

224 $5\% \neq 2.0\% \cdot 0.8 + 1.5\% \cdot 0.6 = 1.6\% + 0.9\% = 2.5\% \ (\Delta = +2.5\%)$

225 Economic Consequences:

- Systemic Crisis: A 25% surplus rate, leading to a wave of corporate bankruptcies and a banking non-performing loan rate exceeding 10%.
- Social Unrest: Unemployment surges to 15%, with the Gini coefficient rising by 0.1.
- Policy Response: Unconventional measures (e.g., nationalizing key industries, capital controls, debt restructuring).

226

4.3 Chain Reactions of the U.S. Treasury Bond Credit Crisis

4.3.1 Mechanism of Crisis Transmission:

- Soaring Interest Rates: U.S. bond selloffs increase global financing costs, widening corporate bond spreads by 300 basis points.
- Dollar Shortage: Emerging market foreign exchange reserves shrink by 20%, triggering currency devaluation and capital flight.
- Trade Freeze: The dollar's settlement shares declines, with barter and local currency settlements rising to 30%.

227 **4.3.2 Additional Shocks to the HQDE equation:**

- Demand Contraction: Global trade volume drops by 15%, with r_b further decreasing by 1.5%.
- Technological Decoupling: Key supply chains like semiconductors are disrupted, causing r_m to decline by 2.0%.

- Capacity Misallocation: A stagnation in $Q(t)$ growth due to reduced foreign investment.

228 **4.3.3 Comprehensive Impact:**

- U.S.: Inflation exceeds 10%, GDP contracts by 3%, and the fiscal deficit reaches 8% of GDP.
- China: Exports decline by 12%, but domestic demand and the Belt and Road Initiative provide a buffer, reducing GDP growth to 3.5%.
- Emerging Markets: External debt default rates rise to 25%, with Sri Lanka-style crises spreading to Pakistan and Egypt.

229 4.4 Policy Choices and Economic Resilience Under Multiple Scenarios

230

Shock Level	Core Challenge	Policy Priority	Potential Loss (as % of GDP)
Mild	Localized excess capacity	Monetary easing + consumption vouchers	-0.5% ~ -1.0%
Moderate	Rising unemployment + deflation	Fiscal expansion + industrial upgrade funds	-2.0% ~ -4.0%
Severe	Systemic collapse + social unrest	Nationalization of key sectors + international debt restructuring	-8.0% ~ -12.0%
U.S. Bond Crisis	Global liquidity drought	Multilateral currency swaps + gold reserve release	-5.0% (global average)

231

4.5 China's Strategic Response Recommendations

4.5.1 Domestic Demand Driven:

- Launch a "Universal Consumer Upgrade Program," distributing 5 trillion yuan in digital RMB consumption vouchers.
- Expand subsidies for affordable housing and new energy vehicles to secure a domestic demand share of over 65%.

232 **4.5.2 Technological Breakthrough:**

- Focus on the full industrial chain of 28nm chips, aiming for a 90% domestication rate within three years.
- Establish a 1 trillion yuan "Digital Economy Sovereignty Fund" to acquire key overseas patents.

233 **4.5.3 Financial Defense:**

- Reduce U.S. Treasury holdings from 800 billion to 300 billion USD, increasing gold and RMB asset holdings.
- Promote the CIPS (Cross-Border RMB Payment System) to cover over 130 countries, raising its settlement share to 30%.

234 **4.5.4 International Cooperation:**

- Build an emergency reserve pool with BRICS countries (scaled at $500 billion).
- Within the RCEP framework, construct a "de-dollarized" trade zone with local currency settlements exceeding 50%.

235

4.6 Conclusion: The Dialectics of Crisis and Restructuring

(1) Short-Term Pain: Under severe shock, global GDP may contract by 5-8%, but crises force structural reforms. (2) Long-Term Opportunities: The decline of U.S. hegemony accelerates multi-polarity, opening a window for RMB internationalization. The green and digital technology revolution reshapes the industrial landscape, with China potentially capturing 30% of the emerging market share. (3) Key Equation:

236

$$\text{Survival Probability} = \frac{\text{Policy Response Speed} \times \text{Technological Reserves}}{\text{Intensity of External Shocks}}$$

237 Only precise policy implementation and deepened openness can turn crises into a springboard for high-quality development.

238

5. Main Conclusions

The HQDE theorem, derived from the system of Capital, offers a scientific basis for balanced development of socialist economies. The introduction and literature review above in this paper support this conclusion. Since 2018, China's high-quality development strategy has led yielded significant economic achievements, empirically validating the theorem's rationality. This suggests that the theory of high-quality development reveals general economic laws for optimal socio-economic operations. Adhering to this theorem ensures optimal economic performance; failure to do so will result in adverse consequences. Cyclical economic crises since the Industrial Revolution have been a persistent challenge. However, this does not imply that the economic domain lacks a globally unique optimal solution. Rather, it highlights that without a full understanding of objective economic laws, economic practices will remain somewhat blind.

239 Understanding the HQDE equation rests on three key points:

1. **Labor Productivity Growth**: Based on Smith's concept of improving dexterity and skill through labor and Marx's axiom that labor creates surplus value, labor productivity generally rises over time. In the continuous production of any product, maintaining a balance between supply and demand requires timely quality upgrades. For example, a family that replaces three TVs over 15 years, each costing 5% of their annual income, sees improved TV quality despite the constant quantity of one TV. This economic law, often overlooked by classical and neoclassical economics, is crucial for maintaining supply-demand equilibrium.
2. **Optimizing Product Quantity and Quality**: Optimal quantity and quality of products should be determined by changes in labor productivity. It is not always better to have higher product quality. When supply exceeds demand, it is advisable to enhance product quality while reducing the quantity of products. Conversely, when demand exceeds supply - such as in cases of natural disasters, social and political unrest, or large-scale wars - it may be necessary to lower product quality to increase the quantity of products available.
3. **Comparative Advantage and Trade Balance**: According to the inertia theorem of value mechanics, different countries have different comparative advantages in natural resources. Therefore, to achieve a comprehensive balance in

international trade relations, new trade equilibrium relationships must be established under conditions analogous to Galilean transformations. This approach ensures that trade policies reflect the diverse resource endowments and economic structures of different countries, thereby promoting balanced global economic development.

240 Marxist economics, as a scientific theoretical framework, integrates qualitative analysis, mathematical modeling, and computer simulations. Marx's Capital offers qualitative insights, while mathematical models address the challenges of value calculation. Corresponding computer models tackle AI problems in complex economic systems that natural language-based AI technologies cannot resolve. Specifically, the HQDE equation in this article provides a concrete algorithm for value calculation in a comprehensive equilibrium system with explicit and analytical solutions. This algorithm can be transformed into advanced deductive AI algorithms for precise calculations of complex global economic problems. Compared to existing natural language AI models developed from neural network algorithms, including GPT in the United States and DeepSeek in China, this mathematically based AI algorithm excels in abstract thinking and complex system calculations. In short, modern Marxist economics and deductive AI technology can bring advanced productivity to the development of the globalized economy, especially for socialist countries.

Примечания:

1. The concept of a "Community of Shared Future for Mankind" was first elaborated in November 2012 during the 18th National Congress of the Communist Party of China. It emphasizes that humanity shares a single Earth, and all countries coexist within one world. This vision has since become a key guiding principle for China's engagement with the global community and was first incorporated into a United Nations resolution in 2017.

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Economic Theories and Case Studies of High-Quality Development Strategies and Trade Protectionism in the Context of International Economic Crises

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Abstract

In recent years, international market competition has intensified significantly, marked by the frequent eruptions of trade wars, financial wars, tech wars, and tariff wars. Notably, the recent international tariff war initiated by the United States, under the guise of reciprocal tariff policies, has triggered intense turmoil in international economic relations. This event, rare and significant in historical context, underscores the necessity for an in-depth exploration of the underlying economic laws. Drawing from an integrated axiomatic system of value mechanics that incorporates classical economics, Marxist economics, and neoclassical economics, this study employs the theorem that the acceleration of product quantity is inversely proportional to product quality and the optimal theorem for value complex functions under holomorphic conditions – based on product quantity, quality, labor value, and use value – to deduce the general equilibrium equation of high-quality development. Utilizing this theoretical framework, the study analyzes various forms of tariff war cases, compares the pros and cons of different decision-making options, and explores the economic laws involved, ultimately aiming to identify the optimal solutions.

Keywords: value mechanics, high-quality development, equilibrium equation, equivalent tariff policy, typical case analysis, optimal solution

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