TESIS DOCTORAL

The US-China race for the economic hegemony in the world-system: Individual and structural power from a network perspective

La carrera de Estados Unidos y China por la hegemonía económica en el sistema-mundo: poder individual y poder estructural en una perspectiva de red

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TABLE OF CONTENTS

LIST OF FIGURES, DIAGRAMS, AND TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

AI - Artificial Intelligence

ASEAN - Association of Southeast Asian Nations

BRI - Belt and Road Initiative

CCP - Chinese Communist Party

COW - Correlates of War

DSR - Digital Silk Road

ECLAC - Economic Commission for Latin America and the Caribbean

Fed - Federal Reserve

GDP - Gross Domestic Product

GVC - Global Value Chains

GT MODEL - General Temporal Model

IPE - International Political Economy

IPR - Intellectual Property Rights

ICT - Information and Communication Technologies

IDM - Integrated Device Manufacturers

IR - International Relations

MIC2025 - Made in China 2025

NA - Network Analysis

NDB - New Development Bank

OECD - Organisation for Economic Co-operation and Development

PPP - Purchasing Power Parity

RMB - Renminbi

SEZ - Special Economic Zones

S&T - Science and Technology

SNA - Social Network Analysis

STEAM - Science, Technology, Engineering, Arts & Mathematics

TiVA - Trade in Value Added

US - United States

ABSTRACT

Since 1978, China's economy has undergone a profound transformation, transitioning from a largely rural structure to a global powerhouse in technology and economy. This shift has instigated academic debate regarding whether China could replace the US as the leading global economic power. This thesis develops a dynamic structural methodology, offering a novel and more in-depth perspective that overcomes the limitations of classic approaches, which focus solely on material capabilities. The objective is to discern whether China is overtaking the US regarding global economic dominance or if this trend will materialize shortly. To this end, an exhaustive comparison of the individual capabilities of both nations in critical areas such as production, technology, trade, and finance is conducted, as well as network analysis of global financial and technological interconnections. This approach provides a detailed insight into each country's structural power and future predictions based on the network growth mechanisms ("the fit get richer" and "the rich get richer"). The findings reveal that although China has significantly enhanced its capabilities, surpassing the US in certain aspects, it is still far from dethroning the US hegemony, which maintains its dominance thanks to its structural power in the financial and technological realms.

Keywords: Hegemony; economic power; global networks; international political economy; China; US.

RESUMEN

Desde 1978, la economía china ha experimentado una profunda transformación, pasando de una estructura mayoritariamente rural a una potencia mundial en tecnología y economía. Este cambio ha suscitado un debate académico sobre si China puede sustituir a EE. UU. como primera potencia económica mundial. Esta tesis desarrolla una metodología dinámico-estructural, ofreciendo una perspectiva novedosa y más profunda que supera las limitaciones de los enfoques clásicos, centrados únicamente en las capacidades materiales. El objetivo es discernir si China está superando a EE. UU. en términos de dominio económico mundial, o si esta tendencia se materializará en un futuro próximo. Para ello, se lleva a cabo una comparación exhaustiva de las capacidades individuales de ambas naciones en áreas críticas como la producción, la tecnología, el comercio y las finanzas, así como un análisis en red de las interconexiones financieras y tecnológicas mundiales. Este enfoque proporciona una visión detallada del poder estructural de cada país y predicciones futuras basadas en los mecanismos de crecimiento de la red ("fit get richer" y "rich get richer"). Las conclusiones revelan que, aunque China ha mejorado notablemente sus capacidades individuales, superando a EE. UU. en ciertos aspectos, aún está lejos de destronar la hegemonía estadounidense, que mantiene su dominio gracias a su poder estructural en los ámbitos financiero y tecnológico.

Palabras clave: Hegemonía; poder económico; redes globales; economía política internacional; China; Estados Unidos.

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1. INTRODUCTION OF THE ISSUE, OBJECTIVES, QUESTIONS, AND HYPOTHESES

Since the end of World War II, the United States (US) has maintained a position of hegemony in the international system, characterized by its superiority in terms of material capabilities and its dominance and influence in the global economy and politics through multilateral international rules and institutions (see: Strange, 1987; Arrighi, 1994; Ikenberry, 1989; Gowan, 2003; Foot et al., 2003; Norrlöf, 2010; Panitch & Gindin, 2013; Cooley & Nexon, 2020). However, since 1980, globalization and economic openness have allowed the incorporation of China into the international system, favoring its dizzying rise as a global power and generating intense debate about the possibility of a hegemonic takeover (Arrighi, 2007; Brooks & Wohlforth, 2016; Winecoff, 2020). This phenomenon has captured the attention of both the academic and the policy arenas, given that the implications of a potential shift in global hegemony are crucial for the stability, balance of power, and future of the international system.

In the case of China, the country has witnessed unprecedented economic growth since the 1980s, emerging as the world's second-largest economy and progressively approaching the gross domestic product (GDP) of the US. In addition, its global influence has expanded by implementing ambitious initiatives such as the Belt and Road Initiative (BRI) and establishing major financial institutions such as the Asian Infrastructure Investment Bank (AIIB). The creation of the New Development Bank (NDB), in collaboration with Brazil, Russia, India, and South Africa, and its strategic partnership with the Association of Southeast Asian Nations (ASEAN) are further examples of its growing prominence globally. These initiatives have been essential in consolidating its position on the world stage, reaffirming its role as a significant economic power.

For approximately 30 years, China's development model has been based on high rates of savings, investment, low-value exports, and low consumption, accompanied by steady population growth (Molero-Simarro, 2014; Lo, 2018; Wagner, 2019; Klein & Pettis, 2020; Li, 2020). However, since the late 2010s, the country's growth has been slowing, leading to a debate about whether China could fall into the middle-income trap (Lo, 2018; Wagner, 2018; Zhou & Hu, 2021; Zeman, 2022) and threatening the country's economic stability. The model faces challenges from two main fronts. First, overinvestment in infrastructure and fixed assets has led to a real estate bubble (Glaeser et al., 2016; Lo, 2018; García-Herrero, 2022). Given the country's declining population, this situation is reaching a critical juncture (García-Herrero, 2022). Second, China's high levels of inequality create additional difficulties. This inequality, stemming from the low proportion of labor in national income and insufficient redistribution, complicates efforts to increase the significance of consumption in the economy (Molero-Simarro, 2017; Klein & Pettis, 2020).

Aware of these challenges, during the late 2000s, the Chinese authorities promoted a shift towards technological progress and the promotion of domestic consumption. These changes took place during the mandates of Hu Jintao first (2003-2013) and Xi Jinping later (2013 up until the moment this sentence is written). The renewed Chinese economic model aims to achieve growth based on domestic consumption, leadership in global value chains (GVC), and technological autonomy, facing internal and external challenges. So far, the weight of consumption in GDP has improved slightly, and this improvement trend has been reversed between 2020 and 2022 (see Chapter 3). However, China has improved the country's technological development, advancing in the GVC and competing in developing cutting-edge technologies such as 5G or artificial intelligence (AI).

A relevant consequence of this transformation, mainly due to Beijing's technological progress, has been increased tensions with the US since 2017, as Washington perceives a threat to its hegemonic position. Thus, the rivalry between these two powers has manifested itself with particular intensity in the technological arena, where both nations are vying for leadership in critical areas such as AI and the deployment of 5G networks.

Tensions between the two countries escalated into a trade and technology conflict. On the one hand, the mutual application of tariffs and trade restrictions began. On the other, a US technological blockade of China mainly focused on preventing Beijing's access to critical US technologies, such as the advanced semiconductor industry, intending to protect technological advantages in critical areas such as AI (Sullivan, 2022). In the current context, there is a growing interest and need to study how China's growth and expansion could change global hegemony, with the Asian nation replacing the US as the dominant power. A change of this magnitude would have profound repercussions on the international order and the stability of the world system, which underscores the relevance of an exhaustive and rigorous analysis of this issue.

The academic literature approached the debate on the possible change in the role of hegemon from different points of view in the field of International Political Economy (IPE) and International Relations (IR). In summary, the debate is divided between those who perceive China as a possible hegemon capable of challenging US leadership (Jacques, 2008; Lee, 2018; Mahbubani, 2020; Dalio, 2021; Moyer et al., 2023) and those who maintain that US hegemony remains solid and resilient (Winecoff, 2020; Schwartz, 2021). Other perspectives propose a multipolar (Vlados, 2020) or bipolar system (Xuetong, 2020) and even raise the possibility of peaceful coexistence (Arrighi, 2007).

However, in the existing literature on hegemony in general, and precisely the case of China and the US, it is observed that most of the analyses are theoretical (Cooley & Nexon, 2020; Nye, 2020), while empirical studies focus mainly on the analysis of individual material capabilities, such as GDP or military spending (Brooks & Wohlforth, 2016; Kai, 2017; Beckley, 2018; Moyer et al., 2023). These studies have significant limitations when studying hegemony since higher material capabilities do not indicate greater power or influence in the world system. Recently, however, approaches focusing on structural power have attempted to analyze hegemony empirically through network analysis, giving greater weight to the system as a whole over the parts (Winecoff, 2015; 2020). Nevertheless, these approaches are static, as they do not study the mechanisms of structure evolution.

Given these gaps in the existing literature, this research aims to assess the current state of global hegemony with a new perspective, applying a dynamic-structural approach. Specifically, it endeavors to ascertain whether China could be an alternative to the US as a global hegemonic power surpassing traditional methodologies incorporating three levels of analysis: static-individual, static-structural, and dynamic-structural.

Thus, the main objective of this thesis is to analyze whether China can potentially replace the US as the global economic hegemon, considering various dimensions, productive, technological, commercial, and financial, and characteristics that define hegemony in the context of the current international system.

In order to achieve this primary objective, the following specific objectives are proposed:

1. To comprehensively review the existing literature to synthesize a cohesive theoretical framework relating to the concept of hegemony and to develop a

methodological framework to provide an in-depth understanding of the critical dynamics and factors influencing potential hegemonic succession between China and the US, and to facilitate the application of this framework at the empirical level.

2. To examine in detail the characteristics and dimensions of China's rise in economic terms and compare its individual capabilities with those of the US to assess and contrast the relative weight of the two powers.

3. To analyze the historical and contemporary dynamics of power accumulation within the global system. Specifically, it aims to assess the relative influence of a country's individual capabilities in driving power accumulation (referred to as the "fit get richer" mechanism) versus the impact of pre-existing structural power within the system (known as the "rich get richer" phenomenon). By investigating these factors, it seeks to offer insights into the potential likelihood of a hegemonic transition between China and the US.

This study's objectives are designed to address and answer the research questions posed below effectively. By synthesizing different views of the concept of hegemony, developing a methodological framework, and analyzing the characteristics and dimensions of the rise of China and the US, we aim to understand better their individual capabilities and how they compare. Furthermore, by studying the structural power of both countries in the world system and the mechanisms driving the growth of power in this context, it will be possible to assess whether China has reached a level of structural power similar to that of the US and whether or not it has the potential to surpass it in the future.

Each specific objective provides the foundation for developing a comprehensive topic analysis. By meeting these objectives, the study will generate valuable insights into

possible hegemonic takeover and the implications this could have for the stability and future of the international system. Ultimately, achieving these objectives will effectively answer the questions posed and enrich the academic and policy debate surrounding the rise of China and the possible shift in global hegemony. Therefore, the research questions are as follows:

1. To what extent has China managed to catch up or surpass the US regarding individual capabilities in the productive, technological, commercial, and financial spheres?

2. What is the relative position of China and the US regarding structural power in the world system?

3. What are the main mechanisms and factors that contribute to the growth of a country's power in the world system, and how can these mechanisms help explain the dynamics of the possible hegemonic transition between China and the US?

4.Considering the mechanisms and factors identified in the previous question, what conditions and future scenarios could China overtake the US as a hegemonic power?

5. Considering the multiple dimensions comprising hegemony, does China have the potential to surpass the US as the leading economic power?

These research questions endeavor to scrutinize China's potential to overtake the US as a global hegemonic power. It does so by investigating the individual capabilities

and structural power that both nations hold within the world system and by exploring the mechanisms driving the growth of such power. In order to effectively address these research questions, an array of hypotheses have been formulated. These examine the correlation between China's economic growth and its structural power, in addition to scrutinizing the importance of individual material capabilities and prior leadership roles within the world system for comprehending the dynamics of economic hegemony.

These hypotheses offer a robust foundation for the research and facilitate a more comprehensive and systematic examination of the matters at hand. This process aids in understanding whether China possesses the potential to contest or even exceed US hegemony in the future. By meticulously analyzing these hypotheses and juxtaposing them against empirical evidence and the existing body of literature, this study aspires to make a valuable contribution to the ongoing debate concerning the potential shift in global hegemony and its implications for the stability and future of the international system. The proposed hypotheses are as follows:

Main hypothesis: China's GDP or trade weight growth does not necessarily translate into a proportional increase in its structural power in the international system. Despite significant advances in critical areas such as technological development, China is still far from reaching or surpassing the hegemonic position of the US.

The secondary hypotheses are as follows:

1. China's growth in individual capabilities has not resulted in a commensurate increase in structural power in critical areas such as technology and finance.

2. The previous leadership position and centrality of the US in the world system in these areas have more determinant in maintaining its hegemony, despite China's improvements in its individual material capabilities

These hypotheses suggest a possible discrepancy between China's economic weight and structural power in the international system. This raises the need to reconsider and expand the conventional approach focused on individual material capabilities to understand the dynamics of economic and political hegemony more effectively in the 21st century.

Given the context, objectives, questions, and hypotheses of this research, the structure of the thesis will be organized as follows (see Diagram 1).

Diagram 1: Thesis structure
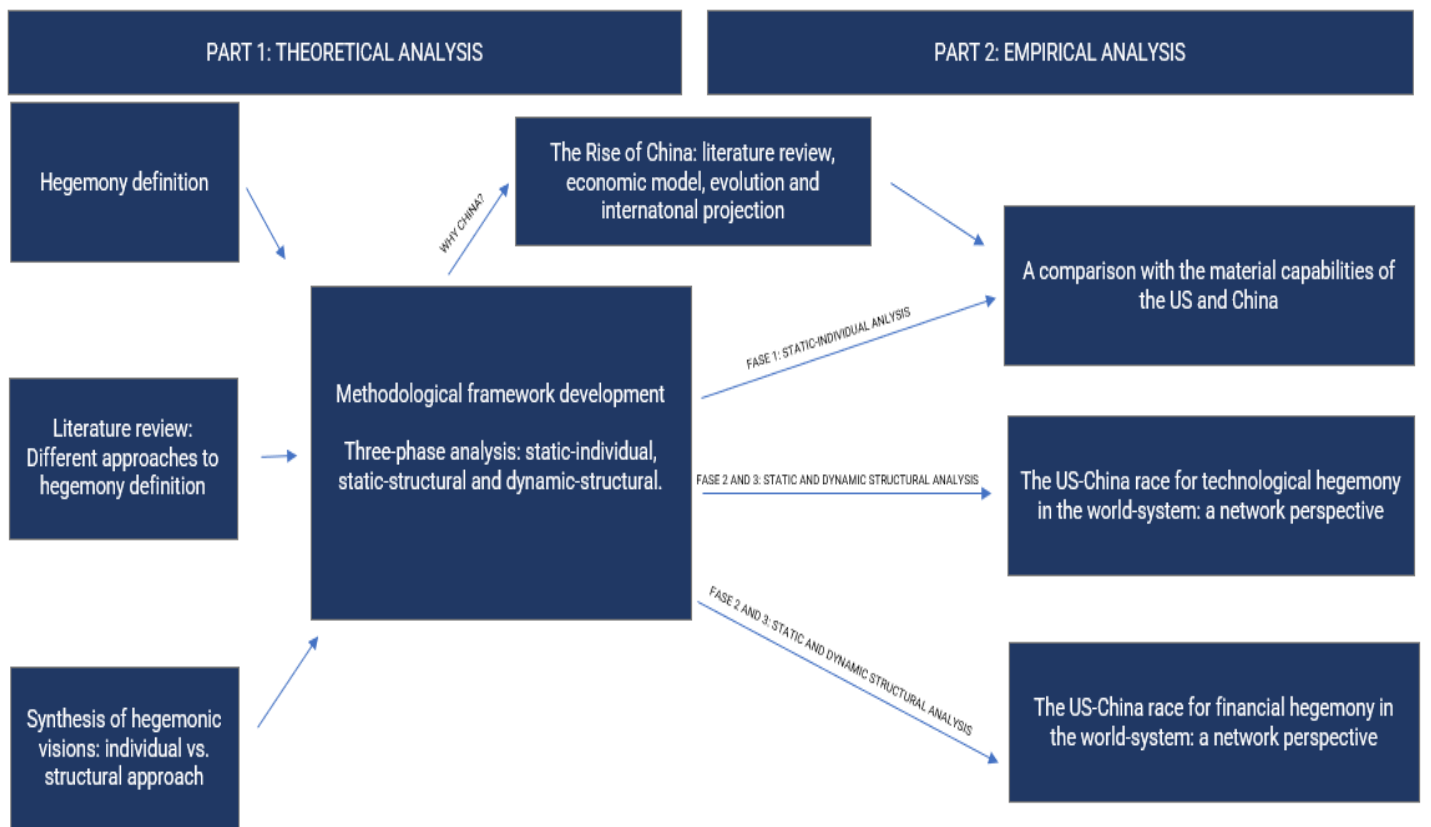
Source: Author's own

In the first part of the thesis, following the introduction (Chapter 2), a comprehensive literature review on the concept of hegemony will be conducted. A proper methodological framework will be developed, suitable for the case study of hegemony in the case of the US and China.

Specifically, the various theoretical approaches addressed throughout history will be analyzed, including realism and neorealism, hegemonic stability theory (HST), power transition theory (PTT), neoliberal institutionalism (NI), structural power theory (SPT), world-system theory (WST), long-cycle theory (LCT), neo-Gramscian theory of hegemony (NGT), and network theory (NT).

After presenting the different approaches, a synthesis of the different perspectives will be elaborated, classifying them into individual capabilities and structural approaches. The former prioritizes the material capabilities of countries (such as GDP or military spending) and bilateral relations. At the same time, the latter argue that the whole is different from the sum of its parts, so the position in a structure is fundamental for analyzing hegemony. The need to overcome the limitations of existing theoretical frameworks will be emphasized, and a synthesis integrating both views will be proposed through NT.

In addition, an analysis of the literature that has attempted to measure hegemony empirically will be made. Despite the great variety of works that discuss the concept at a theoretical level, few empirical studies have been produced. To address this gap in the literature and based on the theoretical proposal of network analysis, a methodological framework will be developed that incorporates the most relevant aspects of the different theories of hegemony and that can be empirically contrasted. Thus, a model combining individual capabilities and structural views is proposed, which will be applied to the case

study of the possible hegemonic succession between China and the US. This model has three phases: static-individual (analyzing the material capabilities of each country), static-structural (analyzing the position of each country in the network), and dynamic-structural (studying the growth mechanisms of the network). In this way, it will also provide a methodological basis for analyzing other cases outside the scope of this thesis.

The second part of this thesis is composed of chapters 3 to 6. We begin in Chapter 3 with a background on the rise of China, analyzing its economic growth model, its strengths, and its limitations at both the national and international levels. After that, an empirical analysis is conducted using the proposed methodology (Chapters 4, 5, and 6). This is done in two stages: first, through an examination of individual national capabilities (Chapter 4), and subsequently, through a structural (static and dynamic) analysis of technology (Chapter 5) and finance (Chapter 6).

First, in Chapter 3, a proper historical and economic context will be provided to understand China's growth as an emerging global power. China's economic growth model will be examined, identifying its strengths and weaknesses and its plans to transform the model, partly explaining the tensions with the US.

Second, in Chapter 4, we will conduct a comparative analysis of the individual capabilities of the US and China in four areas (productive, technological, financial, and commercial) using the first phase of our methodology, which involves static-individual analysis. This analytical approach enables us to comprehend the scope and characteristics of China's economic growth in relation to the US. Additionally, it allows us to evaluate whether this growth leads to a convergence of the structural power between the two countries, a calculation which will be performed in Chapters 5 and 6. By addressing these aspects, the second part of the thesis offers an initial examination of the potential for a shift in global hegemony.

Third, phases two and three (static-structural and dynamic-structural) will be applied to two crucial aspects of hegemony: technological and financial. The aim is to examine the economic power of China and the US from a dynamic and structural perspective, going beyond traditional bilateral approaches focused on quantifying the attributes of each country and complementing the analysis of the second part of the thesis.

On the one hand, the relationship between technological hegemony and the structure of the global value chain, a primary area of conflict between China and the US, will be analyzed. The evolution of international technological relations between 2001 and 2021 will be studied to determine whether China can replace the US as the world technological leader. To this end, the global patent network will be examined as a proxy indicator of international technological influence in the global value chain.

On the other hand, the leadership position of the US in the financial sphere will be explored jointly with how China has implemented strategies to counter the dollar hegemony and boost its financial relations with third countries. The evolution of international financial relations between 2001 and 2022 will be analyzed to determine whether China is moving closer to the US as a global financial leader. The global network of financial flows will be investigated as a proxy indicator of international financial influence. It will focus on each country's position in the network and its growth mechanisms to determine whether the US retains its hegemonic position and China could take it over.

In the last Chapter of the thesis, a global analysis will be made with the conclusions of each section and comparing the individual study with the structural dynamic study to answer the questions and test the hypotheses proposed in this work. Among the main results of the thesis, we observe an evident rise of China in the world economic system, fundamentally in material productive, commercial, and technological

capabilities and, to a lesser extent, in financial capabilities. At the structural level, China has grown mainly at the technological level but not so much at the financial level. At both the individual and structural levels, the US is still ahead of China, although its superiority is more significant at the structural level. Moreover, the dynamic-structural analysis shows that the main growth mechanism of the technological and financial network is the rich get richer, which implies that countries with greater structural power in the past are more likely to maintain their position in the future. This means the US is highly expected to maintain its hegemony in the future, albeit with a systemic rival such as China, which would remain the second most important power.

2. EXPLORING ECONOMIC HEGEMONY: LITERATURE REVIEW AND METHODOLOGICAL PROPOSAL

ABSTRACT

This chapter explores the literature on hegemony, reviewing the various academic approaches that study it theoretically and empirically. It synthesizes the different perspectives between those focusing on countries' maternal capabilities and those focusing on the system or structure. They are then integrated through network theory, and a novel and integrative methodology is proposed to study hegemony, which overcomes the empirical limitations of the literature. This methodology is divided into three phases: static-individual, static-structural, and dynamic-structural.

2.1. Introduction

This chapter targets four key objectives. Primarily, it endeavors to articulate a comprehensive definition of hegemony. Secondly, it aims to provide an extensive review

of the academic literature encompassing the concept of hegemony. Subsequently, it undertakes a theoretical synthesis of the varied perspectives about hegemony, thereby integrating diverse standpoints. Lastly, it formulates a novel methodology to study the potential hegemonic succession between China and the US. Throughout this chapter, we will focus on economic hegemony, defined as the ability of a country (or group of countries) to exercise leadership and establish norms in the international economic sphere, encompassing aspects such as trade, technology, finance, and production. However, beyond this initial definition, there is a broad academic debate on the concept, its application, and the necessary characteristics for a country to be considered hegemonic. Additionally, the literature on the theory and history of hegemony is vast and diverse, including comprehensive reviews from different theoretical approaches (Saull, 2012; Herrera, 2017a, 2017b; Schenoni, 2019; Ikenberry & Nexon, 2019; Sanahuja, 2020).

First, we will examine the origin of the concept of hegemony and its various theoretical approaches, such as realism, neorealism, hegemonic stability theory (HST), power transition theory (PTT), neoliberal institutionalism (NI), structural power theory (SPT), world-systems theory (WST), long-cycle theory (LCT), neo-Gramscian theory (NGT), and network theory (NT). We will also analyze the empirical approach to hegemony, highlighting how it has been measured and studied in the existing literature.

Subsequently, we will synthesize the different approaches to hegemony, dividing between those focused on individual material capabilities and those focused on structure. We will then delineate and address the distinction between theoretical and empirical works within the field of hegemony studies. Primarily, our literature review is heavily weighted toward theoretical underpinnings. It should be noted that all referenced works, from realism to neo-Gramscian, are theoretical. Our contribution in this regard lies not in

further developing these theories but in synthesizing the extant literature to create a cohesive understanding of different approaches to hegemony. Subsequently, our attention shifts to the empirical literature. This body of work is primarily concerned with developing methodologies that quantify and measure the concepts of hegemony as elaborated by the theories mentioned above. It is here that we provide an innovation with existing literature. We take the novel approach of applying a pre-existing methodology, referred to as NA, to the case at hand. This methodology includes specific techniques that have, thus far, yet to be utilized within this field. This methodology approach, called structural-dynamic analysis, will help overcome the limitations of current literature by enabling the analysis of dynamics and factors that could influence hegemonic succession, particularly between China and the US. The ultimate goal of our work is to make this framework valuable and applicable within empirical contexts.

Specifically, this methodology will play a crucial role in future chapters by allowing us to address the hypotheses raised in Chapter 1 effectively. In addition, this methodology will enable us to examine more rigorously how approaches that focus exclusively on individual capabilities may not be sufficient to fully understand the dynamics of economic hegemony in the 21st century.

In this vein, we will develop a methodology combining individual capabilities and structural approaches in three phases to apply to the case of possible hegemonic succession between China and the US. This three-level approach - static-individual, static-structural, and dynamic-structural - will allow for a more accurate analysis of economic hegemony and provide the basis for analyzing other cases beyond the scope of this thesis.

Therefore, this chapter contributes to the academic debate on economic hegemony and presents an innovative methodology for addressing the complexity of the subject in

the current context. With this methodology, we expect to better understand the hegemonic succession between China and the US and establish a framework that can be applied to future studies and cases, enriching the existing literature on IR and IPE.

In this way, we will fulfill the first objective of this thesis which is to comprehensively review the existing literature to synthesize a cohesive theoretical framework concerning the concept of hegemony and develop a methodological framework to provide an in-depth understanding of the dynamics and critical factors influencing the possible hegemonic succession between China and the US and to facilitate the application of this framework at the empirical level.

The work is structured as follows. First, in section 2.2.1, we examine the origin of the concept of hegemony and its various theoretical approaches. Next, in sections 2.2.2.1 through 2.2.2.10, we discuss the theoretical approaches mentioned earlier, from realism to NT. Section 2.2.2.11 analyzes how hegemony has been measured and studied in the existing empirical literature. Subsequently, in section 2.2.3, we provide a theoretical synthesis of the views on hegemony, grouping them into two main approaches: individual capabilities and structural approaches. Section 2.3 presents the proposed empirical/methodological framework based on network theory, which integrates both approaches. Specifically, 2.3.1 focuses on the individual analysis, and section 2.3.2 on the structural and network analyses.

By organizing the work this way, we aim to understand economic hegemony and its various theoretical underpinnings comprehensively. Integrating individual capabilities and structural approaches through network analysis will offer a more robust and nuanced methodology for examining the potential hegemonic succession between China and the US, ultimately enriching the academic discourse on this subject.

2.2. The origin of the hegemony concept and its various approaches

2.2.1. Origin of the concept

In the study of hegemony, several publications make a bibliographical review of the concept from its different conceptions applied to the international arena (Rapkin & Braaten, 2009; Anderson, 2017; Herrera, 2017a and 2017b; Norrlöf, 2017; Dirzauskaite & Ilinca, 2017; Schenoni, 2019; Ikenberry & Nexon, 2019; Fusaro, 2019; Sanahuja, 2020; Saull, 2012; Worth, 2020 and Doğan, 2021). In general terms, there is consensus that the concept of hegemony has its origin in the Greek word *hēgemony*, which as a verb means to guide or lead and as a noun means leadership exercised by a state or group of states (Anderson, 2017; Herrera, 2017a; Ikenberry & Nexon, 2019; Sanahuja, 2020 and Doğan, 2021).

Thus, since its beginnings in Greece, the term hegemony is used as opposed to the term *arché*, the former representing a form of leadership by consent (legitimate and passive) and the latter by coercion or explicit use of violence (Lebow & Kelly, 2001; Wickersham, 1994; Anderson, 2017 and Worth, 2020). From its beginnings, the concept implies various forms of dominance or leadership: by consensus or coercion, which will accompany the term throughout its historical evolution. Moreover, as Hui (2005) points out, it has an equivalent vision in ancient China (Hui, 2005).

Thucydides' famous work History of the Peloponnesian War contains the first use of the term hegemony (Anderson, 2017). This 5th-century BC book deals with the period of Athenian decline as the leader of the Greek city-state system that ended in war. Thucydides used the term hegemony to show how a leading state (or, in ancient Greece, a city) could exercise its authority over others. Furthermore, he illustrated that when

Athens relied on hegemony, it was a more successful leader, whereas if it resorted to more coercive measures of force and control (*arché*), conflicts and crises increased (Anderson, 2017; Worth, 2020 Sanahuja, 2020).

This way of understanding hegemony versus *arché* has remarkable parallelism with Machiavelli's way of understanding power, who, in his metaphor of the centaur, explained power as a half-human, half-animal, that is, as a mixture between hegemony and *arché*, coercion and consent (Worth, 2020). In the 20th century, with significant influence from Machiavelli, the use of the term by the Italian philosopher Antonio Gramsci (1971) generated a significant influence, both in his way of understanding it at the national level and in future derivations applied to international relations (Anderson, 2017; Fusaro, 2019, Sanahuja, 2020). Like Thucydides, Gramsci understood hegemony as demonstrating that obtaining the consent of one class to another provided a stable order (Anderson, 2017). Thucydides and Gramsci have different origins: the former is associated with political realism and strategic international relations, and the latter with Marxist social science and left-wing politics (Worth, 2020).

However, it is essential to note that hegemony in Chinese differs from the Western definition and has negative connotations (Doğan, 2021). The contemporary academic definition of hegemony frequently mentions "leadership" and "consent" as their components. In Chinese, the term "霸权" (bà quán) is used to mean "domination and influence," but the character "霸" (bà) just means "tyrant, feudal lord, rule by force, usurp" (Doğan, 2021, p. 4). The character "权" (quán) means "right, power, authority" or also "weight, balance." The Chinese government advocates that China will never be a hegemon, but that does not mean it does not seek supremacy and dominance in its relations with other countries.

The considerations on the classical concept are relevant because they show two

ways of understanding hegemony that will continue to the present day: hegemony as interstate domination based on the concentration of material power and, on the other, the idea of hegemony as order and justice, based on the consent of subaltern actors through ideational and discursive elements (Sanahuja, 2020; Saull, 2012). In fact, throughout history, from its origin in Greece and ancient China (Hui, 2005) to the founders of contemporary IR (Carr, 1944, 1964), the notion of hegemony is widely shared by the classics. It inspired both the realist strands of HST (Gilpin, 1981; Krasner, 1976) and its NI version (Keohane, 1984; Snidal, 1985), as well as the views of SPT (Strange, 1987), WST (Wallerstein, 1984; Arrighi, 1994; Arrighi & Silver, 1999) or NGT (Cox, 1983; Gill, 1991). In addition, the concept has influenced different disciplines and areas of study, such as economics (Kindleberger, 1973) and history (Kennedy, 1987).

The study of the concept has generated extensive debates throughout the 20th and 21st centuries because it raises fundamental questions about power, in addition to being complex, imprecise, and polysemic (Norrlöf, 2017; Sanahuja, 2020). Despite differences, there is a consensus around the prerequisites for hegemonic dominance. A state must possess superior individual attributes or material capabilities, such as a high GDP, military expenditure, and technological advancement. Further, it demands influential political, economic, social, and cultural ideologies to interact and exert authority over other state and non-state actors (Sanahuja, 2020). Therefore, we may define hegemony as a state that outperforms others in capabilities and leads in establishing and maintaining the international system's rules (Keohane & Nye, 1977; Sanahuja, 2020).

Therefore, when carrying out a bibliographical review of the different approaches that have dealt with the concept, we will begin with an introduction to the realist and neorealist visions since they will influence the rest of the theories. We will then examine the various approaches' analyses of the concept: HST, PTT, NI, SPT, NGT, WST, LCT,

and NT. Additionally, we will review literature that has attempted empirical measurements of hegemony. Following this, we will synthesize these perspectives suitably, categorizing them into individual approaches and structural or systemic approaches.

2.2.2. A review of the different approaches to hegemony

2.2.2.1. The Vision of hegemony from realism

During the 21st century, the experience of the two world wars influenced the analysis of power, being the realist conceptions (Carr, 1944, 1964), the ones that drove the discussion around hegemony applied in the international arena (Herrera, 2017a and Anderson, 2017). The realist conception bases itself on Niccolo Machiavelli, Hegelian rationalism, and, in some aspects, Marxist historical materialism (Herrera, 2017a). For these schools of thought, power politics is the primary tool to act in an international context of Hobbesian nature, in which anarchy is its main characteristic since conflict and competition result from the interaction between societies (Waltz, 1979). Therefore, the state aims to pursue power in an anarchy environment as a starting point.

As a consequence of the above, hegemony in the conceptualization of realism refers to a condition of power imbalance in the international system, in which a State has the material capabilities to lead or dominate the rest (Herrera, 2017a; Dirzauskaite & Ilinca, 2017; Sanahuja, 2020). Specifically, the elements a state must have to be hegemonic are military power, control of raw materials, markets, capital, and a competitive advantage in producing the most critical goods (Li & Zhang, 2018).

In this line, the realist conception is state-centric since what is fundamental in hegemony is the dominance of a state over others in the whole international or regional system from a situation of primacy in the distribution of merely material capabilities

33

(Layne, 2006). Thus, the conception of hegemony is close to the concept of (uni)polarity (Layne, 2006, 2012), that is, of material superiority of one state over others, something much more linked to the hard power of the Greek concept of *arché* than to hegemony more related to leadership.

Concerning the context of international anarchy, this is the same for all actors in the system. Anarchy constrains states' actions since they behave similarly: seeking survival, security, and welfare. Derived from this, for realists, security is fundamental since war is a constant possibility. Cooperation is limited to those moments when relative gains appear on the scene. Ultimately, the international imperative is the rational pursuit of individual state profit, so security considerations subordinate economic gain to political interests (Herrera, 2017a).

Therefore, as Carr (1944) argues, the international system must be established around a hegemonic power to function stably. In order to perpetuate itself, it has to maintain a policy of power and consent, which will make it tolerable to the remaining members of the world community. Continuous negotiation, debate, and imposition by one or a few central actors establish the world order (Herrera, 2017a). This realist theoretical framework will mark the later developments of hegemony, power, and international system concepts.

2.2.2.2. The neorealist conception of hegemony

The neorealist vision of Waltz (1979) and Kennedy (1987) established the frameworks of IPE based on realism. Instead of the concept of hegemony, Waltz (1979) used that of (uni)polarity, which is shared by other classical neorealists such as Brooks and Wohlforth (2008, 2016). Polarity refers to the distribution of capabilities in the international system, not to influence or commit to the institutions, norms, and values that maintain the

international order. Thus, unipolarity without hegemony can erode the international order.

Realist authors such as Kennedy (1987), Waltz (1979), Gilpin (1974), and Allison (2017) establish a correlation between changes in international economic balances and the position of powers in the international system, which influences the rise and fall of great powers (Herrera, 2017a). According to this perspective, significant economic changes, such as the share of world GDP, give rise to the emergence of new military powers with decisive influence on the world order, which generates stages of hegemonic transition culminating in a war for succession (Kennedy, 1987; Gilpin, 2001; Allison, 2017).

The neorealist approach relates great power's economic rise and falls to its military rise and decline (Kennedy, 1987). The dominant hegemony needs economic resources to generate military capabilities to defend its interests and the world order they lead (Herrera, 2017a). Specifically, Kennedy (1987) asserts that hegemony faces frequent challenges from nations capitalizing on the hegemon's overextension in international security commitments. He connects hegemonic shifts to cyclical patterns involving these commitments and the hegemon's economy. He posits that the economic strain of military expenditure erodes the resource base necessary for upholding foreign commitments, thus threatening hegemony.

Therefore, systemic logic drives state to shape an order that reflects their interests, suggesting that unipolarity is transitory and that the structural forces of the system should push the world towards multipolarity.

2.2.2.3. The hegemonic stability theory

Drawing on the principles of neorealism, HST aims to elucidate the unique features of

the post-war liberal international economic order. It highlights the positive effects of a disproportionate distribution of material power in the international system and proposes a more comprehensive theoretical framework for understanding the international order— this contrasts with the traditional realist notion of power balance and imbalance. Therefore, a hegemonic power structure, where one state possesses significant dominance, is considered favorable for establishing a stable, open international economic system.

The origins of HST can be traced back to the work of economist Charles Kindleberger (1973, 1996). His studies on the rise and fall of leadership in the international economy laid the groundwork for the theory. In his examination of the 1929 crisis, Kindleberger (1973) attributed one of the leading causes to the absence of a stabilizing hegemon in the global economy—a result of Great Britain's declining hegemony and the United States' inability to step into that role. This led to the inference that a dominant state's strength underpins the stability of an international system (Keohane, 1980; Kindleberger, 1973, 1996).

Building on Kindleberger's (1973) initial proposition, HST proponents reasoned that a state achieved hegemony by providing direction and stabilization to the international economy. In its absence, the international economy often faced instability and disorder (Kindleberger, 1996).

Specifically, Kindleberger (1973, 1996) argues that providing public goods is crucial to hegemony theory. However, due to the anarchic nature of the international system, it is difficult for international public goods to emerge since any country has no incentive to assume the responsibility of providing them. Only when a state has sufficient capacity and incentives can it assume the cost of providing a public good. Indeed, Kindleberger (1973, 1996) asserts that international economic stability and a liberalized

international market are public or collective goods. However, small and medium-sized countries are unlikely to contribute to their production since their contributions will have little impact on the likelihood of their occurrence.

In this regard, Kindleberger (1973) identifies several functions of the hegemon to stabilize the international economy, which include maintaining an open market for consumer goods, providing countercyclical or stable long-term lending, monitoring exchange rate stability, coordinating countries' macroeconomic policies, and acting as lender of last resort. Thus, in Kindleberger's view, hegemon leadership is central.

Gilpin (1981) and Krasner (Krasner, 1976) admit that collective goods are relevant but argue that states do not necessarily share an interest in international economic stability and liberalization. Although economic openness may improve the welfare of all participants, some states may be disadvantaged relative to others, which may threaten the security of powerful states and limit economic openness. According to Olson (1965), small actors would exploit the hegemon in an open system to pursue their interests.

In the specific case of Robert Gilpin (1972, 1974, 1981, 1987, 2001), he developed the HST incorporating a greater weight of neorealism and security. Using a rational actor model of costs and benefits, Gilpin argues that states will expand until the costs equal or exceed the benefits, and a dominant power will try to define the rules of the international economic and political order. A hegemony is established when a state organizes the international system according to its political, economic, and strategic interests, bearing a disproportionate share of the costs (mainly military) to maintain the *status quo*. As other states increase their capabilities, hegemony eventually declines (Herrera, 2017a; Gilpin, 1974, 1988; Boswell & Sweat, 1991). In this declining phase, international hierarchies are altered when systemic structures no longer correspond to the power distribution and rising states decide to gain their due political weight through a confrontation with the

hegemon. Adhering to game theory logic, a stage of zero-sum interactions ensues, fostering international conflict and instability, ultimately leading to the emergence of hegemony, war, and systemic change (Gilpin, 1972, 1974, 1981, 1987, 2001; Allison, 2017).

Therefore, in general terms, for the HST, the rise of hegemonic power is related to geographic, demographic, and economic factors, the accumulation of financial resources, and technological innovations in the productive and military spheres. In addition, political aspects related to the internal power structure and the capacity and ability to position itself in the international arena are also of great importance (Gilpin, 1972, 1987; Boswell & Sweat, 1991). International economic cooperation, viewed as a public goods problem, benefits all states, with the interstate system founded on hegemon-led public goods provision. The system, known as the international liberal order, emerged under US leadership post-World War II.

In this vein, to quantify whether a state can be considered a hegemon, in addition to the performance of the functions mentioned above, the indicators most commonly used in comparison with other states are the aggregate size of the economy, per capita income, participation in world trade, economic growth rates, share in international investment and share of world monetary reserves (Gilpin, 1974; Krasner, 1976; Kindleberger, 1973).

Through this basis, the three prominent theorists of the HST (Charles Kindleberger, Robert Gilpin, and Stephen Krasner) considered Great Britain as a hegemonic country in the 19th century and the US in the first decades after World War II. During the interwar period, the instability of international economic relations was due to the lack of a hegemon, according to the three authors. The breakdown of the Bretton Woods system in the 1970s initiated the debate on the decline of the US as a hegemonic power, and the HST became a widely accepted explanation of the evolution of the world

economy and the role of the US in it. For the three principal authors of the HST, the US lost its hegemonic status in the 1960s and 1970s, leading to the deterioration of the international liberal order and greater instability.

2.2.2.4. The power transition theory

The PTT, an offshoot of neorealism, originated in the 1980s, intending to analyze the rise and fall of world powers. This framework, developed by Organski and Kugler (1980), underscores the dynamic factors transforming global power structures. It scrutinizes the accrual and disequilibrium of power and how these dynamics can engender novel competitive relations among nation-states. In contrast to hegemony or polarity, PTT focuses on a hierarchy of states that changes throughout history. According to this theory, a transition occurs when a rising power equals 80% of the material capabilities of the incumbent hegemon, and the transition lasts until this power reaches 120% of the hegemon's material capabilities (Kai, 2017).

The typical and most stable power distribution involves a dominant actor at the top of a power pyramid (Kai, 2017). Below the dominant power are the other great powers, a group of central states that are not powerful enough to enjoy the dominant role but have the potential to become rivals of the dominant power (Organski & Kugler, 1980; Tammen et al., 2000). In general, most great powers are content to remain within the alliance with the dominant one. However, under certain circumstances, a state in this group may become powerful and dissatisfied enough to try to change its *status quo*. In such a situation, the challenger state is considered a revisionist power rather than a *status quo* power.

States with relative regional power but incapable of challenging the dominant state or overall system structure occupy the pyramid's mid-level (Kai, 2017). Small states

and colonies lie at the pyramid's base (Organski & Kugler, 1980; Tammen et al., 2000).

Like most authors derived from realism, the PTT pays special attention to security and the possibility of wars between powers (Organski, 1958). Specifically, when powers at the top of the pyramid are dissatisfied, they will have an increasing need to change the rules and order of the system (Organski & Kugler, 1980; Tammen et al., 2000; Kai, 2017). Thus, the level of satisfaction and dissatisfaction is a fundamental element in PTT. In this vein, less powerful states are less satisfied, while more powerful states are more satisfied, with the hegemonic power being generally the most satisfied (Kai, 2017).

Specifically, if weighted by power, the distribution of satisfaction shows an inverted trapezoidal structure, meaning that the single dominant state controls the most significant proportion of power resources, while the largest number of less satisfied states controls less (Organski & Kugler; 1980, Tammen et al., 2000; Kai, 2017). Since the dominant nation controls the most significant proportion of power resources, it does not show apparent dissatisfaction (Kai, 2017).

Great powers may be satisfied with their status and maintain their alliance with the dominant power occupying the leading position. However, great powers may feel dissatisfied with the international order, primarily when these increase their material capabilities (Kai, 2017). Emerging great powers only risk challenging the dominant power and the overall system when they have accumulated sufficient power resources (Organski & Kugler, 1980; Tammen et al., 2000).

Secondary powers in the pyramid, once they attain material capabilities nearing 80% of the dominant powers, seek to reform or reshape international system rules, spheres of influence, and territorial distribution (Organski, 1958; Organski & Kugler, 1980; Tammen et al., 2000). Instability ensues when the rising power's material capabilities fail to surpass 120% of the reigning hegemon's (Kai, 2017). Fundamental to averting conflict

during a power transition is the current power's engagement strategy with the ascending power (Kai, 2017).

For Organski (1958), the three main aspects of power are population size, political efficiency, and degree of industrialization. Generally speaking, when considering material capabilities, the authors of the PTT (Organski & Kugler, 1980; Tammen et al., 2000; Kai, 2017 and Beckley, 2018) focus primarily on two indicators: the Gross National Product and the Correlates of War (COW) indicator, although they also use the Composite Index of National Capabilities (CINC) which represents the average of each state's share of the total and urban population, military personnel and spending, energy consumption, and iron and steel production (Organski & Kugler, 1980; Tammen et al., 2000; Kai, 2017; Beckley, 2018).

2.2.2.5. Neoliberal institutionalism

NI (also known as institutionalism or liberal realism) arises as a response to the limitations of the HST in explaining stability in the IPE despite the supposed decline of the US (Gilpin, 1972; Kindleberger, 1973; Krasner, 1976). This approach, which broadly accepts the assumptions of HST (Saull, 2012; Herrera, 2017a; Sanahuja, 2020), stresses the importance of going beyond the realist approach focused on states, security, and military resources (Keohane & Nye, 1977; Nye, 2021) to explain International Political Economy, which varies according to global contexts.

According to institutional liberalism theorists, such as Keohane & Nye (1977), Snidal (1985), Gowa (1989), and Ikenberry (1989, 2014), the international order is not reducible to hegemonic power, as international regimes have an independent causal effect on world politics. This school identifies the economy and multilateral institutions, along with other non-military factors, as playing a determining role in global governance (Saull,

2012; Worth, 2020).

Building on concepts shared with the neorealists, Keohane & Nye (1977) argue that the international structure conditions the behavior of actors. However, the interaction between actors and the establishment of international hegemonies give rise to the creation of international regimes and institutions that become part of the same structure (Herrera, 2017a) and that play a crucial role in the gestation and coordination of international cooperation independently of the existence of a hegemon (Keohane & Nye, 1977; Keohane, 1980; Nye, 2015, 2017, 2020).

Building on this approach, John Ruggie (1998) and Keohane (1984) criticize the HST assertion that declining US power would lead to instability. There is a hegemonic order that transcends the hegemon, given the common transnational interest shared among the leading states (Ruggie, 1998). Therefore, as long as the dominant state's dominant social groups and ideological approaches are favorable to maintaining the international liberal order, the political consequences of material decline can be mitigated (Saull, 2012). This implies that the international liberal order is hegemonic, cooperative, and based on norms and rules due to the liberal domestic political character of the central states that comprise it and the US in particular (Saull, 2012).

Nye (2021) argues that the measurement of hegemony or power based only on the classic resources of a country (population, economy, and military) is limited since its transformation into adequate power depends on the context and the use made of them. In this sense, Nye (2015, 2021) criticizes the reductionist view of power as possessing the most significant resources since having a population, territory, natural resources, economic strength, and military and social stability does not always translate into power or results. Military or economic power is a hybrid that combines both resources and behaviors (Nye, 2021). Therefore, to assess hegemony, the focus should be on how

resources are converted into power and desired outcomes, with attention to contexts and strategies for converting capability (Nye, 2021). Ultimately, what matters is not the resources, but the results obtained.

John Ikenberry (1989, 2014), based on the realist conception that war is critical to the configuration of international orders, states that liberal orders, and in particular the one led by the US (the international liberal order), have a robust constitutional dimension. According to Ikenberry, consensual legal and political institutions organize the international liberal order. These institutions distribute rights, constrain power exertion, and mitigate political conflicts. They establish active participation and decision-making processes, defining rules, rights, and power boundaries.

Therefore, Ikenberry argues that the international liberal order has characteristics of constitutional order, with institutional arrangements establishing binding limits to the exercise of power, making them difficult to alter. The institutional structure of the international order, while also benefiting the hegemon, notably imposes limitations on its actions. Thus, the US mirrors its open, orderly, and predictable domestic political structures that contain executive and coercive power by establishing and nurturing similar institutional arrangements in the international sphere.

The institutionalist argument posits that a hegemon's material power and political dominance are significant in constructing a liberal international economic order, yet they are not the sole or essential elements to establish order and stability (Arenal & Sanahuja, 2015; Herrera, 2017a). The absence of an evident hegemonic power does not necessarily result in instability and disorder (Arenal & Sanahuja, 2015). Therefore, while a hegemon may facilitate the construction of an international order, this order could endure beyond the hegemon's existence (Arenal & Sanahuja, 2015).

Consequently, international regimes and the institutions formed represent an

independent variable, not solely dependent on the survival of the hegemonic power (Keohane, 1984). Accepting the benefits yielded by the hegemonic order by other actors signifies the consolidation of hegemony. In other words, the rest of the actors accept the hegemony due to interdependence's stability and mutual advantages generated by interdependence (Herrera, 2017a).

In this vein, the international system has evolved towards a complex interdependence, with transnational connections and interdependencies between states and societies on the rise and military force and balance of power in decline, but still significant. The existence of multiple interdependencies implies that an attack would cause severe costs to both the attacker and the target, thus deterring conflict. The concept of complex interdependence includes the emergence of multiple channels connecting societies, including governmental and transnational relationships in areas such as trade, foreign direct investment, technology, and the environment (Nye, 2021).

In the context of economic globalization, interdependence encourages states to gain more through cooperation via international institutions. This cooperation aids the hegemonic state in fulfilling its interests and preserving its reputation within the multilateral arena. Consequently, military force has decreased among states in complex interdependent relationships while remaining an option against states outside these relationships. Complex interdependence stimulates the development of institutions and practices, allowing actors to operate more efficiently without forsaking their interests. Thus, despite traditional views of hegemony as a state's ability to uphold essential interstate relations rules, complex interdependence leads to the growth of institutions and practices, enabling actors to operate more efficiently while still pursuing their interests (Herrera, 2017a).

Finally, based on the importance of constructing institutions, norms, and ideas in

the international system, these authors use the concept of soft power in hegemony. Nye (2021) emphasizes the ability to affect others to achieve desired outcomes through coercion (hard power) or persuasion and attraction (soft power). Unlike realists, liberal institutionalists emphasize the stability that comes from the evolution of economic interdependencies and the power of institutions, reducing the importance of hard power (Nye, 1990, 2015, 2021). The hegemonic order upholds the collective good of an open market for exchanging goods and services free from political interventions. Liberal institutionalists focus on absolute gains and cooperation, while realists focus on relative gains and the propensity for conflict.

2.2.2.6. Structural power theory

According to Benjamin Cohen (2008), a distinction can be made between the American and British schools of IPE, the former being more closely linked to neo-realism and its critics, although without breaking entirely with the realist tradition. The British school emerged with Susan Strange (1983, 1987, 1988), who, influenced by approaches such as NGT and the Latin American dependency school, contributed a new vision of certain concepts in IPE. However, according to Cohen (2008), Sanahuja (2008), and May (1996), Strange did not develop a systematic theory but explored methodological anarchy. Despite this, Strange stood out for her concept of structural power, which is crucial to analyzing hegemony. She points out that it is compatible to integrate the analysis of the realist approach, the Marxist approach, and the dependency theory (May, 1996).

Susan Strange proposed an explanatory theory of the structural dimension of power without constructing a broad theoretical framework of IPE, such as the HST, the WST, or the NGT. The author herself recognizes the impossibility of making prominent explanatory theories in IPE, given the lack of knowledge of the significant variables and

their interaction (Cohen, 2016). What is significant about her approach is that although the theory of structural power starts from a realist epistemology, it leads to an ontology close to those developed by critical theory and, in particular, by NGT (Cohen, 2008; Sanahuja, 2008; Winecoff, 2020).

According to Strange (1983, 1987, 1988), traditional analyses of hegemony and power focus on quantitatively comparing resources, such as production, territory, population, and army, between countries. In contrast, for her, what is fundamental in the study of economic power are structures and relationships, not physical endowments, leading to two dimensions of power: individual or relational and structural (Cohen, 2008; Sanahuja, 2008; Sell, 2016).

On the one hand, individual or relational power refers to persuading another actor to do something it would not otherwise do. In contrast, structural power implies the ability to shape and determine the structures of the international economy, i.e., the power to decide how things will be carried out. This includes setting the frameworks within which states and other actors interact. The actor with structural power can influence a third party without coercion or bribery, as incentives and rewards can naturally elicit a particular behavior. In particular, the actor with structural power can create and modify the choices of others without exerting direct pressure on their decisions. Ultimately, structural power allows for establishing the game's rules within which the other actors must act.

In this way, Strange's approach (1983, 1986, 1987, 1988) moves away from the relational conception of realism, in which power is linked to the capacity to influence another state, i.e., a form of bilateral power determined by a series of options defined around a rational calculation of costs and benefits to achieve a specific national interest (Sanahuja, 2008). Structural power, on the other hand, lies in the ability to define in advance the opportunity costs of each option and the corresponding structure of incentives

and sanctions, as well as to assign roles and determine which behaviors are acceptable and which are not, based on given values (May, 1996; Cohen, 2008; Sanahuja, 2008; Winecoff, 2020).

According to Susan Strange, when beginning any IPE analysis, it is essential to ask: *Who benefits?* (May, 1996; Cohen, 2008; Sanahuja, 2008; Sell, 2016). In this vein, it is necessary to explore the four power structures highlighted by Strange (1988): security, finance, production, and knowledge, which contribute differently and consistently to the structural power of the specific actor under analysis, be it a state, a transnational corporation, or an international organization.

Classical scholars have emphasized the security structure, given that it is the source of power, which stems from providing security against actual or perceived threats, and facilitates the acquisition of material, political, or status advantages. However, Strange (1988) argues that the security structure's prominence over other structures is not inherent but only becomes paramount in conflict scenarios, particularly when war is involved.

The production structure encompasses social arrangements dictating what, how, and for whom goods are produced and the responsible entities. This structure's interaction with its involved actors impacts the outcomes and cost-benefit allocation. Alterations in production methods redistribute power among diverse public and private actors, leading to shifts in states' responsibilities and capabilities. For instance, power distribution between financial and industrial sectors and states' maneuverability capacity have significantly transformed since the 1950s, particularly during the 1980s globalization (Strange, 1988).

For the author, since the 1970s, states have been competing for the means to create wealth within their territory rather than for the domination of more territory. In the past,

states competed for power to obtain wealth, but now the competition is focused on wealth to power. Industrial policy decisions and efficiency in economic management are now more important than foreign policy or defense decisions for resource allocation. This has been pointed out by May (1996), Sanahuja (2008), Cohen (2008, 2016), and Sell (2016).

In addition, it is essential to consider economic actors beyond states, especially the role of multinationals. While states control access to territorial resources and national labor, corporations control capital and technology. Thus, the importance of labor and land-derived raw materials has declined in favor of capital and technology in determining competitiveness.

In this sense, the relationship between state power, internationalization of production, and technological change is fundamental. Technological change decreases the importance of territorially bound factors of production (such as land, raw materials, or labor). It increases the importance of mobile factors (such as capital and technology), which often come together through foreign direct investment. This leads states to develop policies favorable to transnational corporations and foreign capital, which reduces their autonomy in conducting economic policy.

Strange (1988) acknowledged technological advancements as critical components in hegemonic shifts, despite not proposing a comprehensive theory to elucidate such changes. Examples include the influence of nuclear armament and satellites on security and the repercussions of ICT and the Internet on managing financial risks and knowledge structures (May, 1996; Cohen, 2016).

Strange (1986, 1988) extensively examined the structural power of credit and finance, significantly influencing subsequent scholarship, including works by Cohen (2008), Norrlöf (2014), and Winecoff (2015, 2020), among others. Strange (1988) underscored the growing importance of the financial structure in international economic

relations since the 1970s. She posited that credit, not money, is the critical investment component in modern economies and can be created without prior accumulation (Strange, 1986). Therefore, the power to create credit enables economic control, with the State playing a pivotal role in dictating usable currency, ensuring legal security for monetary transactions, and backing leading credit creators, both public and private (Strange, 1986).

The knowledge structure in IPE has received less scrutiny than in power sectors like security or economics. However, knowledge constitutes a significant power source, deriving its authority from knowledge possession and consent. This power can be exercised through control over knowledge storage and communication methods and by managing its dissemination and exclusion (May, 1996; Sanahuja, 2008; Strange, 1988). Despite its importance, IPE has abstractly addressed this domain. Changes influencing this field include alterations in information and communication systems' supply and control, language use, perceptions and beliefs about human conditions, and value judgments underpinning political decisions (Strange, 1988).

Furthermore, there are also secondary structural power structures, such as transportation systems, trade, energy, and welfare. Although these secondary structures are related to the thematic areas of interdependence theories (Sanahuja, 2008), for Strange, this secondary level can only be understood as a product of the four primary structures and the power considerations they contain (Sanahuja, 2008).

Strange (1987, 1988) attributed the persistent US hegemony, including the dollar's role, to four pillars of power: production, finance, security, and knowledge. This perspective served as her critique against declinist views of US hegemony often found in realist and hegemonic stability theories. She posited that the US through its structural power, shapes and chooses the structures of the global political economy, thereby solidifying its hegemonic status.

Cohen (2016) elaborates on Strange's theoretical limitations by noting that power equates to influence and the ability to act autonomously. This means an actor's power increases with its capability to operate independently, resist external influence, and act unimpeded. Power, thus, does not strictly relate to influencing others but also encompasses the capacity to resist external influences. Cohen (2016), therefore, identifies influence and autonomy as two distinct yet interrelated dimensions of power, referring respectively to its external and internal aspects.

While IPE primarily centers on the external influence one actor exerts over another, it also acknowledges the internal power dimension of autonomy (Cohen, 2016). Autonomy converts into influence when deliberately used to achieve political or economic objectives but remains separate otherwise. Exerting international influence seems unfeasible without first securing a degree of domestic political independence. Actors must primarily enjoy freedom from external constraints to exercise authority elsewhere. While this does not necessitate complete autonomy in all international relations aspects, it suggests that power originates at the national level (Cohen, 2016). Cohen (2016) critiques Strange's overlook of power's internal dimension (autonomy), arguing that this leads to a misconception that power has vanished when it simply morphs into different forms.

As a way of updating Susan Strange's idea of states and markets, Babic et al. (2017) extend the study of international politics beyond state-centric views, arguing for a more nuanced understanding of power relations in a world characterized by transnational capitalism. They propose an innovative framework that incorporates both state and corporate entities as significant actors whose actions and interests, while distinct, collectively shape the global political economy. This paradigm recognizes the dynamic and context-dependent interactions between these actors, challenging the notion that

power relations are dominated exclusively by states or corporations. Instead, they emphasize that these entities often coexist, compete, or cooperate in complex networks, with power dynamics fluctuating according to specific contexts, such as state ownership or extraterritorial funding. In doing so, Babic et al. (2017) encourage a shift in focus from the strategies of individual actors to the systematic examination of relationships and patterns of action within these networks, offering a more comprehensive lens through which to analyze and understand contemporary international politics.

2.2.2.7. World-system theory and hegemony

In the 1970s, in parallel to the development of HST, the debates on American declinism, and the neorealist developments of hegemony, the WST was born. The most relevant author of this school is Immanuel Wallerstein (1979, 1984, 1988, 2006), whose influences come mainly from two analytical strands: the Economic Commission for Latin America and the Caribbean (ECLAC) school and the School of Annals, whose second-generation author, Fernand Braudel (1974), was the first to speak of world-systems. The authors of the ECLAC school and the dependency theorists were the first to theorize about the division of the world between center and periphery, a key aspect in WST. Authors such as Immanuel Wallerstein, Giovanni Arrighi, Beverly Silver, Christopher Chase-Dunn, Samir Amin, Gunder Frank, and Minqi Li, among others, have been fundamental in developing WST.

The concept of a world system, as described by Wallerstein (2006), constitutes a spatiotemporal realm spanning various political and cultural entities. It signifies an interconnected zone characterized by a network of activities and institutions adhering to specific systemic rules. Individuals, states, interstate systems, and social classes do not

exist in isolation. Instead, they form components of a larger overarching matrix, which encases them and facilitates the system's functioning. This matrix, a product of social construction, nurtures a range of conflicts and contradictions that persistently recur. Wallerstein (2006) argues that specific mechanisms can explain this socially constructed matrix, further underscoring its crucial role in shaping world systems.

According to Wallerstein (2006), the world economy, as the economic form of the world system, has evolved since the 15th century, turning capitalism into a unique system in the history of humanity due to its progressive autonomy and globality, which has encompassed more and more areas of the planet. This modern world economy originated in Western Europe in the 16th century and became the globally dominant system in the 19th century (Wallerstein, 1979). Capitalism has formed a stable systemic unit, which has allowed it to become the first stable world economy (Aguirre, 2003). In addition, the modern world system includes an international division of labor, a great variety of cultures, and an inter-state system with considerable political powers (Aguirre, 2003).

Regarding the analysis of the concept of hegemony, for Wallerstein (1984), it represents a situation of power imbalance in which one power stands out from the others because it can impose, to a large extent, the rules of the game and dominate the different fundamental areas of the world-economy: production, trade, and finance. Derived from this premise, the world-system theory conception of hegemony emphasizes the state-based class and material forms of a hegemony shaped and maintained by a global division of labor. This division generates self-reinforcing economic, political, and military hierarchies (Wallerstein, 2006).

On the other hand, the conception of hegemony by Giovanni Arrighi (1994, 2007) and Beverly Silver (Arrighi & Silver, 1999) is closer to the neo-Gramscian concept, considering hegemony as the additional power available to a dominant group to direct

society in the direction that benefits it, this being understood by the dominated group as its own, that is, the dominant group makes its particular interest pass for the universal interest of society (Arrighi, 1994). The fundamental difference between hegemonic and non-hegemonic governments lies in domination with consent and legitimacy, which implies moral leadership, and domination without consent, which implies the threat or use of force (Arrighi, 1994).

In the interstate system, the dominant state exercises a hegemonic function if it leads the system of states in the desired direction. This is perceived as the pursuit of the general interest. This concept is close to the original Greek concept of hegemony as a synonym of leadership as opposed to *arché* since the expansion of the power of the hegemon for other states is perceived as a common good, as the general interest of the rest of the actors (Arrighi, 1994). For Arrighi (1994) and Arrighi and Silver (1999), fundamental aspects of economic hegemony are technological and trade leadership, the monopoly of the hegemonic currency in world finance, and leadership in military capabilities. On the contrary, when a power loses its hegemony, it enters into a progressive decline, leaving, in the last instance, in financial and military dominance before another power or group of powers definitively redefines the hegemony of the world economy.

In WST, the long cycles of the world economy are crucial to explaining the rise and fall of hegemons. For Wallerstein (2006), long cycles are directly related to Kondratieff's long waves since the introduction of new technologies and the forms of production that derive from them allow the introduction of new products that have wide acceptance in consumption, stimulating the expansion of the market and investments and, therefore, the reproduction and accumulation of capital (Herrara, 2017b).

The succession of hegemons begins in the 16th century (Netherlands, Great

53

Britain, and the US) that coincide with Kondratieff's long waves, with wave A corresponding to the boom stage and wave B to the decline of the hegemony and the emergence of a new one (Wallerstein, 2006). Derived from the A and B phases proposed by Wallerstein, Arrighi proposes a similar perspective with the systemic cycles of accumulation, which he relates to the upswing or productive phase and the downswing or financial phase. For Arrighi (1994), the expansive phase of hegemony has to do with the development of the productive sphere until it reaches a crisis of overaccumulation, which has as a way out of the expansion of financial channels (phase b). This explanation, that of financial expansion in the phase of hegemonic decline, is an adaptation of Braudel's work, which pointed out that the end of hegemonies coincided with financial expansion (Braudel, 1974).

In both cases, in the stage of decline, new candidates for hegemony are born, leading to a stage of increased tensions, instability, and even systemic chaos (Arrighi, 1994) and (Arrighi & Silver, 1999). First, the deterioration of a state's hegemony occurs in the productive (manufacturing) sphere and then in the commercial and financial spheres. As Wallerstein (2006) points out, hegemons bear a burden in political and military resources to maintain their dominance that eventually erodes their position, which coincides with the rise of other powers that may be candidates to occupy the role of the hegemon. Situations of hegemonic transition coincide with times of greater instability, which has led to successive wars (Wallerstein, 1974, 1979, 1984, 2006; Arrighi & Silver, 1999).

In general, the WST agrees that, at first, the hegemon stands out for its agricultural and industrial superiority, high productivity, and leading technological development. These advantages in production also entail advantages in prices. Thus, the hegemon is encouraged to establish a free trade system that allows it to maintain almost unrestricted

54

access to the world economy by having a cost-benefit ratio that is favorable to it, i.e., the costs of sustaining this system are outweighed by the benefits it obtains from it (Herrera, 2017a; Sanahuja, 2020).

Market supremacy in cutting-edge sectors can only be temporary because, at some point, these will begin to be replicated in other centers (semi-peripheral and even peripheral) as the diffusion of technology allows the forms of production to spread. The intensification of competition precludes the monopolization of emerging, cutting-edge sectors. Therefore, the cultivation and oligopolization of these sectors become imperative to instigate a novel reservoir for capital reproduction and aggregation. This process epitomizes a cyclical pattern within the global economy, characterized by the sequential ascendency and regression of hegemonic powers, as well as the advent of nascent ones (Herrera, 2017a).

Although WST proposes a different view of hegemony than other theories, such as that of HST, some critics suggest that the understanding of hegemony in WST largely resembles that of the neorealist variant of WST. However, according to Sanahuja (2020), the view of hegemony and hegemonic order in WST is more complex than in realist approaches, albeit with a similar bias towards the nation-state. WST adopts a relational approach to understanding hierarchy in the world economy, focusing on the distribution of economic surplus through center-periphery relations in the functioning of the world economy (Saull, 2012).

2.2.2.8. The long cycle theory

Building upon the theoretical and conceptual foundations of WST and Wallerstein's (2006) adaptation of Kondratieff's (1935) A and B phases, LCT endeavors to elucidate the cyclical ascension and decline of hegemonies. Modelski (1978, 1987, 1995) and

Thompson (2020) further accentuate the significance of scrutinizing these lengthy cycles for understanding human development. As Thompson (2020) articulates, cycles constitute an intrinsic element of humanity, given the natural cycles connected to Earth's rotation, human lifespan, and the human body's necessity for rest. With world politics predominantly driven by human actors, the existence of cycles in the international economy should be anticipated.

Consequently, LCT's arguments on leadership derive from systemic changes predicated on the assumption that human processes are evolutionary. LCT's primary postulate asserts that world politics has consistently experienced cycles of resource concentration, dispersion, and shifts in material capabilities (Thompson, 2020). Thus, the cycles of prosperity and decline among powerful nations align with broader economic cycles of boom and expansion, where technological change plays a pivotal role.

The origin of leadership cycles is a sequential process in which a leading economy emerges as a significant source of radical economic innovations that boost productivity, transportation, and trade. Thus, if PTT material capabilities measured through the population and military are fundamental, LCT leadership focuses on technological innovation analysis (Thompson, 2020).

Specifically, Kondratieff's thesis, relevant to LCT, posits that many discoveries and inventions emerge in production and communication technology during the long-wave recession. However, their large-scale application typically ensues in the subsequent expansionary cycle (Kondratieff, 1935). Kondratieff attributed the fluctuation in economic growth rates to innovation rates, which was the foundation for developing his version of the K-wave theory. In turn, Joseph Schumpeter (2008) leveraged this theory to formulate the concept of innovation clusters.

Derived from the above, like specific neo-Schumpeterian authors (Pérez, 2010),

LCT authors suggest that each new Kondratieff wave corresponds to a new technological paradigm (Modelski & Thompson, 1988, 1996; Berry, 2000; Modelski, 2001, 2006; Grinin et al., 2017). Thus, the LCT of leadership suggests that Schumpeter's rounds of creative destruction coincide with leadership changes (Thompson, 2020). Old technology and energy are replaced and upgraded in some respects by the new technology and energy used (Thompson, 2020).

The leading sectors at the center of technological advances are at the center of systemic change, and their leading carriers stimulate the economic growth of the system leader's national economy and the world economy (Thompson, 2020). Moreover, according to Thompson (2020), the chronology of long economic waves suggests that each period of systemic leadership spans two K waves. Thus, each hegemon leads two long waves of economic growth. A state pioneers a new wave and technological frontier, propelling it to the top of the systemic hierarchy. The resulting instability in relative systemic positions, usually established by a long period of decline by the system leader in question, triggers a period of systemic crisis or global war (Thompson, 2020).

In turn, Modelski and Thompson (1988, 1996), Grinin (2013), Grinin and Korotayev (2010, 2013, 2015, 2016), Grinin et al. (2017), and Thompson (2020) argue that technological and economic changes function graphically in an S-shape and find this type of behavior in technological innovation over the last 1000 years. Radical technological change occurs neither incrementally nor randomly. Their introduction is clustered in time and space and has life cycles in which their employment is initially low. Following their initial development, these innovation clusters experience swift growth until they reach a point of maximum efficiency or productivity. Beyond this point, their growth tends to slow (Thompson, 2020). Each cluster, spanning boom and bust periods, lasts about 40-60 years. Spatially, the new technology first appears in an innovating

economy and diffuses unevenly and sometimes quite gradually, depending on how easily other economies can copy or adapt the new way of doing things. In this way, the pioneer economies become the leading economies in the global system (Grinin & Korotayev, 2013).

Since hegemonic powers operate at the frontier of technological change and can produce goods unmatched in other economies, they can benefit from the demand for their products, the higher standard of living of their populations, and a larger share of world GDP (Thompson, 2020). Derived from this, the emergence of a new leading economy is destabilizing for the global power hierarchy, as long waves transform the culture of economies and geopolitics at the same time. These technological changes create revolutions in people's lives, commodity production, and who benefits most from structural change. Therefore, long waves are essential drivers of economic development worldwide and the engine of change in social processes (Thompson, 2020).

2.2.2.9. Neo-gramscian theory of hegemony

Simultaneously, as alternative theories to realism and HST, like WST and SPT, was gaining traction, the theoretical framework of the NGT of IPE was emerging. The key proponent of this approach, Robert Cox (1983), adapted Gramsci's theory and Braudel's (1974) historical structures to analyze the international system (Sanahuja, 2020). Nevertheless, Cox was not alone in incorporating Gramsci into the international analysis; Arrighi (1994), within the WST framework, also drew upon the Italian author's work. However, as we shall see, the development of NGT diverges notably from WST, primarily due to its move away from state-centrism.

Drawing inspiration from the classical interpretation of historical materialism and

Gramsci's concept of historical blocs, Cox (1983, 1987, 1993) and Stephen Gill (1991, 1993) argue that the essence of hegemony extends beyond coercion or a state's material power. Instead, they propose it relates to the process of diffusing domination, rendering it the natural order of things. International organizations and norms, spearheaded by the institutionalized coalition of the dominant bloc (comprising principal actors such as states and corporations, along with their primary allies), facilitate this power dispersion (Li & Zhang, 2018).

Sanahuja (2020) presents the NGT concept of hegemony, which, emerging from this theoretical framework, urges a shift away from the state-centric and interstate focus inherent in other theoretical frameworks like HST or WST. Consequently, the dominant group on the international stage more closely resembles a capitalist class than a state-formed bloc or group. NGT terminology labels this concept as a global historical bloc. Therefore, a comprehensive understanding of hegemony examines state power and delves into the historical structure's context and its constituting elements (Saull, 2012; Herrera, 2017b; Sanahuja, 2020).

The definition of hegemony in this approach conceals a core of legitimacy, more akin to its classical Greek meaning. Therefore, power extends beyond material capabilities, drawing support from cognitive elements, norms, and institutions (Sanahuja, 2020). Echoing elements of structural power and WST, this perspective explores the structural aspect of power, not just its relational dimension, and highlights the consensual form of power that operates through civil society (Bieler & Morton, 2004; Sanahuja, 2020).

Specifically, global hegemony comprises a set of structural dimensions: social, economic, and political (Cox, 1983, 1987, 1993; Li & Zhang, 2018). These three structures define the character of the world order at a given historical moment. A world

order arises from changes in the mode of production and the emergence of new socio-political forces, which leads to the construction of new forms of functioning of states.

Furthermore, for NGT, institutions set the rules of the game that facilitate the reproduction of a given hegemonic order, co-opting the elites of peripheral countries that integrate counter-hegemonic ideas or projects, avoiding the need for the use of hard power or direct coercion (Cox, 1983; Sanahuja, 2020).

The elements of a historical structure delineate an action framework and confine the choices available to actors, particularly those occupying subaltern positions. Moments of weakened hegemony open opportunities for structural changes. They are paving the way for the rise of counter-hegemonic movements and potentially constructing a new power bloc (Li & Zhang, 2018; Sanahuja, 2020).

2.2.2.10. Network theory and hegemony

NT, and in particular, social network analysis (SNA), scrutinizes social structure through links that bind various actors or nodes—entities like individuals, countries, or companies—in diverse contexts (Borgatti et al., 2009). This approach leverages mathematical concepts and methods to unpack and interpret social relationships and behaviors, finding application across several domains of social sciences, including economics (Borgatti et al., 2009).

In this view, researchers consider structures or systems as a "small world" where actors engage with each other via relationships or connections between nodes. These nodes might represent either individuals or collectives, such as companies or states. Links act as conduits for information, resources, or other forms of influence, facilitating bi-directional flow. The degree of a node refers to the number of connections it maintains

with other nodes.

The topology or structure of the network refers to the established pattern of nodes and links. It is the product of actors' past actions and significantly influences their future behavior.

Social network analysis has become increasingly popular in international relations and economics. This allows researchers to map the topology of the international trade network and develop network-based measures of international economic integration (Kali & Reyes, 2007). In international relations, network analysis enables the investigation and measurement of network structures, which can define, enable, and constrain agents (Hafner-Burton et al., 2009). Social networks are the most frequent cause of international market entry and systematically affect the organizational form of entry (Ellis, 2005). Lastly, social network analysis has been used to measure enterprises' investments in social capital (Westlund & Nilsson, 2005). Overall, social network analysis has proven to be a valuable tool for understanding the complex relationships and structures in international relations and economics.

The field of international economics has increasingly adopted network analyses in its studies. A pivotal work in this arena is by Kali and Reyes (2007), who merged data on international trade linkages with network methods to scrutinize the global trading system as a complex, interdependent network. These authors proposed novel network-based measures of international economic integration, applicable on both global system-wide and local country scales. Their measures considered the trade volume and a country's impact on the international trading system. Babic et al. (2017) implement network analysis as their primary method to dissect the intricate power relations between states and markets. They regard states and corporations as actors operating within a network structure, enabling a granular, precise, and empirically rich understanding of these

61

entities' roles in modern international politics. Utilizing recent advancements in network analytical techniques and burgeoning relational datasets on state and corporate behavior, they open the door for systematic research into global power dynamics. Their analysis includes a range of relational aspects, such as ownership structures, value chains, shared elite memberships, international organizations affiliations, and policy planning groups. Furthermore, their bottom-up approach that leverages large-scale firm-level data effectively bridges the methodological gap often found in global capitalism analyses that rely on aggregated national data to explain transnational trends. Their approach bypasses the national/transnational divide, offering a direct analysis of relations rather than indirect inferences drawn from national statistics. Khan et al. (2018) presented a study asserting that local firms embedded within the global value chains of multinational enterprises cultivate international networks. This strategy allows them to balance and engage in exploratory innovations in late-liberalizing economies. Other significant contributions include Engel et al. (2021) research, which delved into the application of network analysis tools for economics and finance, particularly in the context of firm ownership. Likewise, Chaney's work (2014, 2016) offered a comprehensive exploration of the structure of international trade from a network perspective.

On the theoretical front, one of the most relevant works connecting network analysis with international relations is Hafner-Burton et al. (2009). According to the authors, network analysis allows the study and measurement of network structures that emerge from the interactions between international actors. These network structures can display an unequal distribution of weights or importance among actors, implying a power imbalance. The authors point out that international economic networks are often asymmetric, in which exchange is concentrated and circulated among a few key actors. These actors benefit from this position and maintain it over time, thereby hindering

changes or alterations in the network.

Global economic networks significantly influence the power dynamics and interdependence among states. Network growth models suggest that topologies possess self-reinforcing characteristics, indicating that changes are more likely to bolster the prevailing uneven distribution pattern rather than undermine it. Moreover, the central nodes within the network enjoy greater access to information and relationships, enhancing their learning capacity. Other network members, aiming to maintain access to these learning processes, seek to establish connections with these central nodes, thus fostering increased collaboration within the network. Despite their resistance to change, states can learn to exploit these network structures as tools of coercion under certain circumstances (Farrell & Newman, 2019, 2021).

The interaction of agents within a network indicates that actions are interdependent, and one's behavior is susceptible to the decisions of others. Unlike other perspectives, such as the neorealist view, these relationships are intrinsically dynamic, suggesting continuous evolution and transformation (Hafner-Burton et al., 2009). In this context, power no longer solely originates from individual attributes or material capabilities. Instead, a country occupying a central network position—maintaining strong links with many other countries—can yield greater power through easy access to resources and information. This paradigm facilitates the identification of a hegemonic node within a network, the existence of alternatives to such hegemony, and the analysis of dynamics that could potentially trigger a change in this dominant position.

Oatley et al. (2013) and Oatley (2015) also highlight the importance of understanding the global financial network and its relationship with power distribution among nations. Thus, the authors point out that global economic networks reveal a hierarchical structure and concentration of power, contrasting the common notion of

economy and global trade as horizontal and decentralized systems.

In his studies, Winecoff (2015, 2020) identifies hegemony as the capability of an actor to shape global structures that govern interactions among other actors. Winecoff further elaborates on the concept of network hegemony, drawing upon Strange's structural power approach. He asserts that it is possible to associate structural power with network theory and measure it utilizing network analysis tools. These tools facilitate the identification of the most central and connected actors across various domains, including finance, trade, security, and knowledge.

To comprehend the actor's positions within these structures, Winecoff employs the concept of network centrality. This metric quantifies the significance or prominence of an actor within a specific network. The actors possessing the most centrality in these networks are the ones wielding the most power and influence over global structures and stand to benefit from them. Contrary to popular beliefs about the decline of American hegemony, Winecoff's analysis suggests that the US remains the most central and interconnected actor across the four networks he scrutinized.

Similarly, Farrell and Newman (2019) explained how network topology can generate persistent power imbalances among states. Their analysis draws on sociological and computational research on large-scale networks, showing that complex systems tend to produce asymmetric network structures in which some nodes are more central and more connected than others. These asymmetric network structures can generate what the authors call "weaponized interdependence," where some states can leverage their position in an integrated network to gain a bargaining advantage over others. Critical actors in a network can block economic flows and information exchanges, discover and exploit vulnerabilities, force political change, and deter unwanted actions. In this way, the authors argue that global economic networks reveal a hierarchical structure and concentration of

power, in contrast to the common notion of economy and global trade as horizontal and decentralized systems.

In summary, these concepts, related to hegemony theories, allow for identifying and evaluating network properties and comparing theoretical approaches and assumptions in economics, trade, and international relations (Hafner-Burton et al., 2009). Moreover, the authors note that analyzing these relational structures provides a comprehensive understanding of the system, as examining the relationships and structures constraining and enabling actors is possible (Hafner-Burton et al., 2009). This approach, similar to structural perspectives on hegemony, focuses on how material and social relationships create structures among actors through dynamic processes.

2.2.2.11. Empirical analyses of hegemony

Analyses that study hegemony generally fall into two categories: theoretical or, when empirical, descriptive. This categorization remains true regardless of the chosen methodological approach. Even when these studies employ an empirical framework to analyze specific instances, such as the decline of the United States or the ascent of China, their analyses tend to remain descriptive. The traditional attempts to quantify a state's hegemony or power usually involve comparing essential attributes and aggregates, such as the size of a nation's Gross Domestic Product (GDP) or military expenditures.

According to Schenoni (2019), since the 1990s, some authors have focused their research on polarity and long cycles (Singer et al., 1972; Modelski, 1987) to measure critical variables representing material capabilities. In this context, there have been debates on whether the hegemon's capabilities should be measured compared to other powers (Mansfield, 1994) or the whole system (Conybeare, 1987). Some authors, such as Diehl and Goertz (2000) and Oneal and Russett (2001), have used dyadic approaches to

compare material capabilities and performance. On the other hand, authors of the long-cycle theory (Modelski, 1987; Grinin & Korotayev, 2010, 2015; Thompson, 2020) have empirically studied cycles of economic growth, population, urbanization, and technological development through linear regression models. Beckley (2018) notes that early authors who attempted to measure hegemony focused on capabilities and outcomes, mainly with HST and PTT. In classical theories of hegemony, national economic power is conventionally considered as industrial production, trade volume, and GDP, which are closely associated with the study of China's rise (Liu & Tsai, 2020). However, several authors have criticized this perspective (Beckley, 2018; Liu & Tsai, 2020; Winecoff, 2020).

Most PTT approaches use indicators such as COW (Correlates of War) or Gross National Product to measure hegemony. Specifically, COW is a research project that collects and analyzes data on international wars and conflicts since 1816 and is used to measure a country's material capabilities (Oneal et al., 1998). In addition, both HST and PTT studied the concepts descriptively, highlighting national raw indicator data over time, such as the share of world GDP to measure the share of power or the volume of world trade to measure the degree of openness and absence of wars (Gilpin, 1981; Keohane, 1984; Krasner, 1976; Organski, 1958).

One of the most recurrent debates in the literature is the alleged decline of the US, which began in the 1970s and has been the subject of numerous analyses. In the late 1980s, competing positions emerged between Strange (1987, 1988) on the one hand and Milner and Snyder (1988) on the other, on how to measure US decline. While Milner and Snyder (1988) argued that Strange did not provide sufficient data to support their thesis that the US share of world production had remained constant, Strange (1987, 1988) responded that relying solely on such a share was insufficient to demonstrate a decline.

Strange (1987) argued that the US remained the hegemonic power because of its world reserve currency, finance, technology, and security leadership. These components pointed to the superiority of US capabilities relative to other states (Norrlöf, 2010).

During the 1990s, much of the research in this field focused on polarity and long cycles (Modelski, 1987; Singer et al., 1972), intending to measure critical variables. However, a debate arose as to whether the capabilities of the hegemonic country should be measured in comparison with other major powers (Mansfield, 1994) or concerning the system as a whole (Conybeare, 1987). This debate led to an increase in dyadic approaches, which focus on measuring power differences and outcomes between each individual state in the system (Diehl & Goertz, 2000; Oneal & Russett, 2001; Lemke, 2002). For their part, authors of the LCT, such as Modelski (1987), Modelski and Thompson (1996), Grinin and Korotayev (2010, 2015), and Grinin et al. (2017), have used linear regression models to analyze the cycles of economic growth, population, urbanization, and technological development, demonstrating that leadership change at the global level coincides with the transition of a technological paradigm.

In this sense, global leadership change has become a recurring topic of debate, especially in the case of the alleged decline of the US, a debate that began in the 1970s and has continued to the present day. While some authors argue that the US has lost power in economic, technological, and military terms compared to other emerging powers (Beckley, 2018; Liu & Tsai, 2020), others point out that it remains the hegemonic country in terms of global reserve currency, financial leadership and international security influence (Strange, 1987; Norrlöf, 2010).

Several theories and approaches have recently emerged to study global hegemony empirically. For instance, Kwon (2011) developed a hegemony index founded on both hegemonic stability theory and long cycle theory, which assessed the power structure of

the capitalist world system from the 16th century through 1945. Despite this, Kwon acknowledges the lack of consensus on the most appropriate indicators for measuring states' relative power, even though there is agreement on the categories that define hegemony. The indicators used in Kwon's index included GDP, GDP per capita, and naval power.

More recently, Brooks and Wohlforth (2016) made a comparative study of the economic strengths of China and the United States by analyzing gross national indicators such as GDP per capita, productivity, public debt, research and development (R&D) spending, and human capital stock. They propose that these indicators are adequate to assess superpower status. Their analysis suggests that the US will remain the world's only superpower for a considerable duration. Nonetheless, they recognize the significance of China's economic growth and validate the global attention it has received.

On the other hand, from a realist perspective, Michael Beckley (2018) criticizes how hegemony is measured through gross resource and flow variables, such as GDP, which may capture a country's recent performance but do not provide insight into the total wealth and military assets. Instead, Beckley measures the balance of power in terms of net resource stocks and uses flow measures only to gauge trends in the balance of power. To create an index, Beckley uses GDP and the Combined National Capability Index (CINC) as proxies for the standard (gross) approach to measuring power and GDP multiplied by GDP per capita as a proxy for an alternative (net) approach. It calculates the difference between the gross and net resource balance for each year by subtracting the latter from the former and taking the absolute value of the difference. In addition, following the UN and World Bank approach, the stock of wealth is divided into three broad categories: human, produced, and natural capital.

In addition to realistic approaches that measure hegemony through gross resource

and flow variables, others focus on security analysis and use different statistical models. For example, Lake (2007) highlights that troops stationed in a subordinate state, the number of independent alliances in which that state participated, and its exchange rate and trade dependence on the hegemon are indicators of authority in the security and economic spheres. In later work, Lake (2009, 2010) applied dyadic quantitative analysis to study bilaterally negotiated social pacts between dominant and subordinate states and generated and tested more specific hypotheses.

Regarding the security domain, Debs and Monteiro (2014) analyzed whether significant power shifts resulting from economic growth are generators of armed conflict. Using a game theory model, they found that transparency in the military investment decision prevents violence. In contrast, lack of transparency may tempt states to introduce power shifts as a fait accompli.

For their part, Urdinez et al. (2016) measured hegemony through regional power in Latin America of the US and China. They constructed a temporal dataset for 21 Latin American countries. They empirically measured Chinese economic penetration using three strategies: foreign direct investment, bank lending, and Chinese manufacturing exports to Latin America.

From a neo-Gramscian and structural perspective of power, Liu and Tsai (2020) criticize the usual theories of global power and hegemony, both realist and liberal institutionalist, pointing out that measuring hegemony is erroneous. In this regard, they argue that, depending on the different stages of the modern era, the keys to considering a country as hegemonic change. For example, in the era of mercantilism, the key would be trade volume and the size of GDP in the era of industrial capitalism. Today, a country's power is directly related to its position on the global value scale and patent remittances, with technological development being a key factor. In addition, Liu and Tsai argue for

the importance of combining internal and external aspects in a mix of comparative economics, political science, and international relations. They point out that without understanding a country's internal economy, its external aspirations and contradictions cannot be understood. In this sense, China's internal limitations would be critical to conclude that it will not be a hegemonic power and that its power is overestimated, at least for the time being. Although the authors attempt to use indicators different from those used in classical studies, they limit themselves to analyzing the evolution of linear indicators over time, such as the return on assets of Chinese industrial companies, the number of patents, the size of multinational companies, the percentages of China's export sales in medium- and high-tech industries, participation in global value chains and fees for the use of intellectual property.

From different theoretical perspectives, Norrlöf (2014) has assessed the relative monetary capabilities of countries and the influence of national currencies on public and private markets. Starting from a theoretical framework that combines Strange's (1987) structural power and Cohen's (2016) autonomy, Norrlöf (2014) analyzes countries' monetary capabilities concerning their share of GDP, world trade, capital markets, military power, and financial openness. Through this analysis, monetary hegemony is connected to monetary capabilities, and the dollar's role in international markets is examined. Meanwhile, Norrlöf and Reich (2015) test two hypotheses that examine the role of the US and China as global economic stabilizers in times of crisis. The results suggest that China is increasingly important in supporting the global economic system. In another paper, Norrlöf and Wohlforth (2019) examine the costs and benefits of US hegemony in the current context of shifting relative power and economic interdependence. The authors develop a theoretical framework that identifies conditions affecting the complementarity between military protection and economic production and

use network analysis to study security network patterns and interstate connections. The authors find that the US has a central position in the security network, and its allies have a high economic dependence on it. The authors argue that, under these conditions, the hegemonic order remains beneficial to the US but also poses challenges to its sustainability. The authors suggest that the US could reduce the costs of hegemony by decreasing military spending and increasing multilateral cooperation.

In 2019, the McKinsey Global Institute (Woetzel et al., 2019) comprehensively analyzed China's global scale and integration. To measure China's relative exposure to the rest of the world and vice versa, the study considered three critical dimensions of economic flows: trade, capital, and technology, and created a China-World Exposure Index. For trade, both a country's supply and demand were assessed, considering a country's exports and imports and the consumption and production of the rest of the world. Regarding capital, both outward and inward FDI and investment opportunities were analyzed. Finally, in technology, a country's exposure to technology exports, including both intellectual property exports and technology services and equipment, was measured and divided by the R&D spending of the rest of the world. The report compares China's exposure with other major economies such as France, Germany, India, Japan, the United Kingdom, and the US. The average exposure index was set at 1, with values above 1 indicating that the world is more exposed to China than the seven large economies on average. In contrast, values below 1 suggest the opposite. The results show that economic flows between China and the world have increased over the past two decades. Although the methodology employed in this study does not focus on explicitly measuring the autonomy of countries, it could be helpful for this purpose. According to Benjamin Cohen's (2008) theory, autonomy is complementary to Strange's (1987) structural power. Therefore, the China-World Exposure Index could be a valuable tool for assessing a

country's autonomy regarding economic flows.

Ba (2020), drawing on the concept of complex interdependence, examines the effect of US centrality within the international banking system and argues that changes in the US financial cycle drive international financial volatility and crises. These dynamics form the basis of US financial hegemony and pose a fundamental challenge to US leadership in the contemporary liberal international order. He uses a cross-sectional time series analysis to assess the effect of the US financial cycle on the likelihood of other countries experiencing a surge or disruption in capital flows (Ba, 2020).

Oatley et al. (2013) propose a network approach to analyze the global financial system and its relationship to power and stability. The authors consider the global financial system a hierarchical network, where central nodes have more connections and influence than peripheral nodes. The authors explore how the network structure affects financial contagion dynamics and actors' power distribution. The authors argue that the network approach allows for constructing a systemic international political economy that is theoretically and empirically pluralistic.

Within network analysis, one of the authors who has made an essential contribution in the field is Winecoff, who, in his 2015 and 2020 works, explores the influence of the US in the global banking network and links structural power in world politics with the science of complex networks. In his 2015 study, Winecoff highlights the relevance of the global banking network as the center of the world economic system, providing the financing for economic activities that shape other economic networks. By analyzing banks' cross-border holdings of assets and liabilities, he demonstrates that US banks exert control over financing conditions in the international banking network. Furthermore, in his 2020 paper, Winecoff provides a theoretical framework for understanding how global structures develop and change in finance, trade, security, and

knowledge. He empirically analyzes the role of leading states in these networks. In his analysis, Winecoff studied the centrality of countries in the network over several years and found that countries with greater centrality in the past have greater centrality in the present. This suggests that structural mechanisms are more important than individual ones. It also used financial flow data from the International Monetary Fund (IMF, 2023), trade flows from the World Trade Organization's Trade in Value Added database (WTO, 2022), mutual defense alliances and security agreements, and patent data to study knowledge and technology. However, it is recognized that Winecoff's approach in his 2020 work was static, as it did not dynamically integrate the entire study period or quantify growth mechanisms.

In their seminal work, Moyer et al. (2023) performed an in-depth comparative analysis of Chinese capabilities vis-à-vis the United States. They proposed an innovative multidimensional metric for evaluating relative national capabilities and employed the International Futures model to project power dynamics across 29 scenarios. Their study results suggest that, in 26 of these scenarios, Chinese capabilities could outstrip the US before 2060, with the power transition most frequently predicted to occur in the early 2040s. These results highlight the vital need for leaders to recognize and respond to the gap between national perceptions and current shifts in power dynamics. Such awareness and proactive action might help reduce the potential for conflicts arising from such transitions.

In summary, Thus, empirical studies on hegemony have focused on individual aspects statically (Brooks & Wohlforth, 2016; Beckley, 2018; Moyer et al., 2023), individual aspects dynamically (Modelski, 1987; Grinin & Korotayev, 2010, 2015), and structural aspects statically (Winecoff, 2015, 2020). These reflect a limitation in the study of hegemony as structural and dynamic analysis is necessary to study the evolution of

hegemony or the possibility of change over time.

2.2.3. Theoretical synthesis of hegemony visions: Two approaches to power

Having reviewed the different perspectives, this section will present a synthesis of the approaches that analyze power and hegemony in the international arena, distinguishing between the individual capabilities approach and the structural approach. The former measures a country's power by its material capabilities, such as GDP, relative to other countries. The latter examines a country's power according to its position in the international structure or system, with its dynamics and workings. This section proposes the need to integrate both approaches to obtain a complete understanding of power and hegemony in the international system.

Specifically, the individual dimension of power refers to the need for a country to have superior material capabilities over others, such as higher GDP, population, or military, and the predominance of its political, economic, social, and cultural ideas, to play a hegemonic role. In a bilateral relationship, the more powerful country would have superior individual attributes, for example, a higher GDP. Although most theories recognize the importance of these capabilities, neorealism, PTT, HST, and even WST give them greater relevance.

These theories argue that the system influences and constrains the behavior of states, although they define the system as anarchic, so their study is left in the background. However, NGT, WST, SPT, or NT interpret the world as a set of interdependent social, political, and economic relations that form a standard structure, and being at the center of this structure confers a hegemonic role that brings substantial benefits. Thus, a country that wants to strengthen its influence must enhance its centrality within these systems. In this way, structural approaches give equal or greater importance to the whole, which has

its dynamics, so that the whole is different from the sum of its parts.

From a structural perspective, the power of one actor over another is more significant if it controls the structures that define the interaction, as opposed to simply being the most vital partner in a bilateral relationship (Sanahuja, 2020). Therefore, the country with greater structural power is considered hegemonic, meaning that the main advantage of this position is the ability to create and modify the choices of others without exerting continuous and direct pressure to determine their decisions.

In this work, we consider that the hegemony perspective has been enriched by including the structural aspects of power. By focusing only on individual attributes and not on the country's position in the global structure, critical elements for achieving political and economic objectives at the global level are ignored.

Liu and Tsai (2020) critique the limitations of hegemony theories that solely focus on material capabilities when assessing power dynamics in our contemporary world. The determinants of a country's hegemonic status have evolved throughout modern history. During the mercantilist era, trade volume was vital, while GDP size took precedence during the industrial capitalism era. Today's economic system, however, embodies a high level of complexity and relies heavily on global supply chains. This shift has promoted the widespread acceptance of the "complex interdependence" concept as a basis for studying international economic relations. Nevertheless, unlike complex interdependence, we assert that interdependencies shape a hierarchical system that does not necessarily mitigate conflict. As Brooks (2017) articulates, globalization has created a system where all flows - financial, informational, commercial, or commodity - can transform into potential weapons. This situation introduces new risks for states and novel tools to leverage or counteract those risks. Complex interdependence can coexist with competition and rivalry among states, leading to an increasingly intricate system.

Globalization has escalated interdependencies among nations, thereby triggering new inquiries regarding states' or businesses' effective utilization of structures. The emerging political landscape underscores an increasing cognizance of the potential for weaponizing interdependencies, as detailed by Farrell and Newman (2019). For instance, in 2013, Thomas Wright alerted the global community to the destabilizing vulnerabilities introduced by a globalized economy, singling out Chinese firms like ZTE and Huawei. Additionally, the World Economic Forum released a white paper highlighting the risk of weaponization of globalization's structural aspects, spanning sectors such as finance, trade, supply chains, and energy (Drezner, 2021). These concerns have manifested in recent confrontations, such as the technological standoff between the US. and China and the financial and economic conflict stemming from Russia's invasion of Ukraine.

Thus, the US government has taken advantage of its centrality in technological and financial networks to impose sanctions and blockades, operating under the principle that armed interdependence is an omnipresent reality of 21st-century international relations. With the rise of China, the US fears that the BRI will generate economic, financial, or technological networks that make the rest of the world more dependent on China, which could make recipient countries overly dependent on China and weaken their decision-making capacity. The new rise of industrial policy in the US, China, and Europe is directly related to strengthening autonomy and reducing risks within international economic networks.

Taking this into account and following the line of authors linking NA with IPE, such as Hafner-Burton et al. (2009), Winecoff (2015, 2020), or Farrell and Newman (2019, 2021), this work considers that TR allows integrating individual and structural analysis. To integrate both visions and apply them to the case study of China and the US, it will then develop a methodology that allows the study of hegemony, power, and its

evolution over time by attending to individual and structural aspects, as well as the mechanisms that drive the evolution of the system, both at the theoretical and empirical levels. This will make it possible to overcome the static-individual and static-structural analyses, to include a dynamic and structural perspective as a new phase.

2.3. Methodological framework: the two visions of power and network theory

This thesis examines China's rise and its ramifications on the international system, especially in juxtaposition with the US. The study incorporates a bifurcated analytical strategy for achieving this goal: a network analysis for individual and structural scrutiny.

The individual analysis will be applied in Chapter 4, focusing on comparing China and US in four key dimensions of economic hegemony: productive, technological, commercial, and financial. By examining these categories, the study aims to provide insight into the relative positions of the two countries regarding their economic influence and potential for hegemony.

The structural analysis, on the other hand, delves into the financial and technological aspects of the two countries by employing network analysis techniques. This approach allows for a more in-depth examination of the complex relationships and interactions within the global financial and technological systems, highlighting the structural positions of China and the US within these networks. By combining both individual and structural analyses, this thesis aims to provide a comprehensive understanding of the evolving economic hegemony of China and the US. The detailed methodology for individual and network-based structural analyses will be presented and discussed in the following sections, laying the groundwork for an in-depth exploration of

the critical dimensions of economic hegemony in the context of these two global powers.

2.3.1. Individual capabilities analysis

Our analysis of economic hegemony focuses on individual material capabilities, considering four key categories we have synthesized: productive, technological, commercial, and financial. By concentrating on these areas and incorporating additional factors within each, we provide a comprehensive and nuanced understanding of the economic hegemony of the US and China, grounding our assessment and comparison of their hegemonic positions in these critical areas within the context of the challenges and changes in the 21st-century global economy.

Before delving into the analysis of material capabilities in the areas of hegemony, we explore in Chapter 3 he evolution of the Chinese economy and its transformation through various stages to contextualize its growth and potential threat to the hegemony of the US in the global sphere. We examine China's rapid emergence as the "world's factory," the shifts in its growth model, its development into a technological superpower, and its role on the international stage. This initial contextualization allows us to effectively address the analysis of material capabilities in financial, productive, commercial, and technological hegemony.

Following our analysis of China's rise and evolution, in Chapter 4, we compare its material capabilities with those of the US in the four critical areas of economic hegemony: financial, productive, commercial, and technological. These areas are based on a synthesis of categories proposed by prominent authors in our literature review, such as Strange (1988), Wallerstein (1984), Arrighi and Silver (1999), Kai (2017), and Brooks and Wohlforth (2016).

Our focus on these areas allows us to assess and compare the hegemonic positions

of China and the US in fundamental aspects of the global economy, considering potential changes and challenges in the 21st century. By analyzing the material capabilities of both countries in these areas, we gain a more comprehensive and nuanced understanding of their respective positions in the world economy and the changing dynamics of economic power. Consequently, our analysis contributes to a better understanding of the evolution of economic hegemony and the factors that may influence the balance of power between the US and China in the future.

Below we will detail the four areas that make up economic hegemony through our own classification. Chapter 4 will detail the indicators and data used to implement this methodology.

a) Productive Hegemony

Productive hegemony refers to a nation's capacity to generate goods and services and impact the productive global landscape. This study adopts a methodological approach to assess the productive hegemony of China and the US, focusing on crucial dimensions illuminating their production capacity and influence in the global market. These dimensions encompass the production of goods and services, productivity levels, the significance of significant companies in the global economy, and the prominence of trademarks and industrial designs associated with each country on the global stage.

Productive hegemony refers to a nation's capacity to generate goods and services and significantly influence global production. In our research, several fundamental dimensions will be addressed to assess the productive hegemony of the countries in question.

Each nation's capacity to generate value through producing goods and services is considered. This dimension extends to considering how a country's production translates

into its stature and participation in the global economy. Also, we address the efficiency of each economy, with a particular focus on the labor force's productivity. This dimension allows us to understand how each nation can generate value from its labor resources and the efficiency with which economies use their labor force.

On the other hand, the importance of leading companies in the global economy is considered. These large corporations play a vital role in each country's productive capacity, impact the global economy, and influence global production and GVC.

Moreover, the role of intellectual property in productive hegemony is considered, mainly through the trademarks and industrial designs associated with each country. Intellectual property registrations indicate each country's capacity to disseminate their production throughout GVC and organize global production.

Finally, foreign direct investment indicates a country's ability to attract external resources and knowledge, as well as its influence and participation in global production networks. This ability to attract and issue foreign investment indicates a country's productive capacity and potential to influence production and standards globally..

b) Technological Hegemony:

The study of technological hegemony involves examining a country's technological prowess, encompassing advances in research and development (R&D), innovation, patent acquisition, technological diffusion across borders, and participation in advanced industries. This component of hegemony is crucial, as it influences a nation's competitiveness and ability to maintain global leadership.

Technological hegemony denotes a country's aptitude to establish and preserve leadership in the conception, production, and implementation of state-of-the-art

technologies, enabling it to control the global economy and secure economic and strategic benefits. Dominance in R&D, innovation, human capital development, production and commercialization of emerging and disruptive technologies, and the ability to define and govern international standards and regulations in the technology sector constitute technological hegemony.

This study adopts a methodological approach that evaluates indicators and empirical data across various technological domains and sectors to examine the dynamics of technological hegemony between China and the US.

Firstly, we scrutinize the role of research, development, and innovation (R&D). Significant investments in these areas indicate a nation's commitment to cutting-edge technology and a drive for technological advancement. This also reflects its capacity to compete globally and sustain a leadership position in the world economy.

Subsequently, we examine the nation's capacity to produce and commercialize emerging and disruptive technologies. A country capable of innovating and bringing new products and services to the market demonstrates a strong technological hegemony indicator. This component also mirrors a country's ability to convert technological competence into tangible economic benefits, an essential aspect of technological hegemony.

Patents are another pivotal component of technological hegemony. A nation with many patents granted domestically and internationally demonstrates a robust, innovative capacity. Patents also indicate a nation's global influence and ability to shape global innovation trends.

In addition, we analyze a country's capacity to monetize its technological innovations and their impact on global markets. The revenues derived from using intellectual property can offer a measure of the financial benefits gained from

technological advancements.

The cultivation of human capital is another integral component of technological hegemony. The quality and skills of a nation's workforce often dictate the pace and scope of technological advancements. A country that can foster and develop talent is better equipped to compete in the technological arena.

Finally, a country's capacity to lead in emerging technologies is considered. A nation that can develop and deploy critical technologies that are likely to define the future, such as renewable energy, artificial intelligence, and 5G, is in a strong position in terms of technological hegemony.

c) Commercial Hegemony:

This category delves into a country's international trade relations, market access, and standing within global supply chains. Factors such as exports, imports, trade agreements, and their role in shaping global trade patterns can offer insights into a nation's commercial hegemony.

To analyze the commercial hegemony between China and the US, we employ a methodological approach that evaluates various trade indicators, including the share of world merchandise trade and trade in services. This examination entails studying the evolution of trade links for each country, their positioning within GVCs, and their respective roles in shaping global trade patterns and international trade relations.

A key aspect to consider when studying commercial hegemony is the nature and extent of a country's trade interactions on the international stage. This can be understood by examining a country's share in the world trade of goods and services, reflecting its international market transaction volume. A significant share implies a commanding role

within global trade, conferring upon the country the power to influence trade patterns, norms, and international agreements.

We also consider a country's export relationships with various regions, as this gives us an understanding of its geographic sphere of influence. For instance, a high volume of exports from the US to Europe would suggest a strong influence within the European region. In contrast, extensive exports from China to Africa could indicate a significant economic influence on the African continent.

Another crucial factor is the number of trading partners that regard a country as their primary trading partner. The extent of a country's trade network can provide insight into its ability to influence the global economy. A country with a large number of trading partners is more likely to be able to influence global trade rules and policies.

In addition, the value-added dimension of trade can indicate a country's position within global value chains and its ability to capture value in the highly profitable stages of these chains. This can be understood through a country's ability to enhance the value of the goods and services it exports, which signifies economic competitiveness and sophistication.

d)   Financial Hegemony

Financial hegemony reflects a country's financial system's influence and weight and the power it wields in the global financial system. In our empirical analysis of the financial hegemony of China and the US, we examine critical aspects of their financial capabilities and how these elements contribute to their position in the global financial system.

A significant indicator in this study is the size, structure, and share of the Chinese and US financial markets within the global equity and bond sectors. By evaluating these facets, we can infer each country's significance within the global financial architecture

and gauge their capacity to direct global financial flows.

Another crucial area of analysis is the usage of different currencies, specifically the US dollar and the Chinese yuan, in international payment transactions and within the foreign exchange market. This sheds light on the global preference for US and Chinese currencies in international trade and financial investments, signifying the relative weight of each currency in global trade.

Additionally, an exploration into current account balances, representing a country's trade balance and net income from abroad, provides further insight into each country's financial capabilities.

2.3.2. Power as a network phenomenon: a dynamic structural approach

Following our examination of individual material capabilities and economic hegemony, we now focus on the structural analysis. To effectively transition from the focus on individual actors to a broader structural perspective, we introduce an innovative approach that combines both viewpoints, allowing for a more comprehensive understanding of the complexities of hegemony.

Building upon the insights from our previous analysis, we propose integrating individual and structural analysis with network theory, which enables us to combine the perspectives of individual actors and the overarching structure of the system. By employing NT, we can investigate the interactions between individual actors and examine how these connections shape the system's structure. Concurrently, this approach allows us to analyze the system's structure's impact on the individual actors.

To integrate the two perspectives of hegemony, we propose an approach that combines structural analysis with that of individual actors. Using NT, we can unify both perspectives and empirically contrast the notion of hegemony. In this way, it is also

possible to carry out a dynamic-structural study as an evolution of static-individual and static-structural. Using NT, we can examine how individual actors interact with each other and how these interactions shape the structure. This integrated approach allows us to examine the complex dynamics of hegemony and explore how power relations are built and change over time.

This methodology framework provides a more comprehensive understanding of the intricate dynamics of hegemony, allowing us to delve into the construction and evolution of power relations over time. By integrating individual and structural perspectives, we offer a more robust analysis of the changing nature of hegemony in the global political economy.

In this way, building on the works of Winecoff (2015, 2020) and Pham et al. (2016), we develop three levels or phases of analysis: static-individual, static-structural, and dynamic-structural. In the first level, we examine individual and static power, i.e., countries' material capabilities or individual attributes. In the second level, we use a static-structural analysis, which considers network centrality measures as a proxy for structural power or hegemony. Finally, in the third level, we address the dynamic aspect and study the network's growth over time, assessing whether the drivers of such growth are related to countries' material capabilities or structural position in the network. This process allows for a more comprehensive understanding of hegemony by integrating different perspectives and levels of analysis. Additionally, it provides a broader and more detailed view of the factors contributing to hegemony and its evolution over time.

As previously discussed, NT studies the relationships between nodes and the links that connect them. A network comprises nodes and links, forming an interdependent system with a specific topology, influencing the network's growth over time (Jackson, 2008). NT offer methodological tools to study networks and the individual distribution of

nodes and links (Jackson, 2008).

The links between nodes can be different, such as directed or undirected, and binary or weighted. Directed links, also known as oriented, indicate the starting and ending points, while weighted links quantify the connection between nodes. For example, to study transnational patent, money, or product relationships between countries, it can be represented as a weighted matrix $W = (Wij)$ ($N \times N$), where the weight Wij represents the number of patents, money, or products from country i to country j (Yang et al., 2019). In this case, the links are oriented from node i to node j in a directed network, so $Wij \neq Wji$. Since we focus on cross-border relationships, we establish that $Wii = 0$ for any country i. The resulting network can be abstracted as a graph $G = (N, L)$ composed of a set of nodes N and a set of links L (Yang et al., 2019). These networks are dynamic and evolve as new relationships emerge and others disappear or change in intensity.

First, we will analyze the weight of countries in the network. To do this, the input and output values of each country in the network, also called in-strength and out-strength, are measured. In-strength refers to the total number of connections recorded by a country, while out-strength measures the total number of connections recorded by a country abroad. Powerful countries register many connections abroad and are considered prestigious. In-strength and out-strength measures are also used to measure a country's relevance in the network.

According to Winecoff (2020), if we consider the leadership role of a country as a function of structural power, which we can measure by examining centrality and connectivity within global structures, then we can understand hegemonic structural power as a network phenomenon. Highly connected countries occupy central positions in the network and influence the entire system significantly. They can control access to resources and establish connections between isolated network parts, thus exerting control

power. Moreover, changes within central countries can stabilize or destabilize other parts of the network (Winecoff, 2020).

In this context, power is defined as a country's capacity to influence global networks that determine interactions among other countries. The most central actors in these networks possess greater power and influence, benefiting from their previous positions in the network. We measure network centrality by considering the number of connections, position, and influence of a node, allowing us to understand the actors' positions within global structures. Hence, an actor with higher centrality than others can be considered hegemonic.

Moreover, countries can use interdependence as a weapon, leveraging their structural position to gain advantages over their adversaries. An example is the US, which drove the international intellectual property rights system and the established international technology standards, which helped spread US companies' technology (Schwartz, 2019). When a technology becomes a standard, companies worldwide must use it and pay a fee for it, creating a clear position of dominance (Schwartz, 2019). Additionally, this also grants it the power to block the use of its technology, as in the case of the chip war against China, in which it prevents Beijing's access to American technology to manufacture advanced microchips.

Network centrality analysis of countries allows for determining whether a hegemonic country exists, whether hegemony is shared, and whether it has changed over time. Specifically, following Winecoff (2020), we use two centrality measures: betweenness centrality and eigenvector centrality. Betweenness centrality measures the number of shortest paths in the network that pass through a given country (Choe & Lee, 2017) and indicates the competitive advantage of an actor during intermediation (Yang et al., 2019). Countries with high weights for this indicator have significant intermediation

functions, creating dependencies among the rest. Eigenvector centrality quantifies the level of influence, prestige, or status. Countries with high values for this centrality measure are connected to many countries that are, in turn, relevant, while countries connected to peripheral or irrelevant countries have low eigenvector centrality. Countries with high values in both centrality measures can be considered more potent from a structural perspective and are the most suitable candidates for hegemony. According to Winecoff (2020), if a country is the most central in the network, then we can say that the country is hegemonic. If there is no such country or substantial instability in the system's organization over time, then either there is no hegemony, or there may be a change.

Third, we will analyze the mechanisms that influence network growth and the relevance of countries over time. These mechanisms are complex and vary depending on temporal network models. Nodes in the network establish new connections through various processes, two of which are especially important: the node's current position in the network and its attributes. That is the individual or structural aspects of a country.

Bianconi and Barabási (2001) explain how various complex systems, such as the world wide web, business networks, or citation networks, follow a pattern of evolution consisting of three phases. In the first phase, all nodes in the network possess similar characteristics, and they create new connections randomly. During the second phase, nodes with high values in relevant individual characteristics are more likely to form new connections through the "fit get richer" or "fitness" mechanism. This phase highlights the importance of material capabilities. The third phase, known as the Bose-Einstein condensate phase, is characterized by nodes with high structural power, as they attract most new connections through the "rich get richer" or preferential attachment mechanism. Structural power plays a vital role in this phase. It is important to note that the second and third phases can coexist, with fitness and preferential attachment mechanisms acting in

conjunction.

Examining the relative weight of these mechanisms in the network's evolution helps us understand the framework within which power is established over time. The high weight of preferential attachment describes a situation where leadership changes occur infrequently. On the other hand, a significant influence of the "fit get richer" mechanism suggests a greater likelihood of hegemonic technological changes.

In this phase, the goal is to identify the coexistence of two network growth mechanisms and observe which one adapts better to the specific case. The preferential attachment mechanism refers to growth associated with a node's current position in the network. In contrast, the fitness mechanism refers to the growth of connections due to a node's attributes or qualities. These mechanisms are associated with the "rich get richer" and "fit get richer" phenomena.

The "rich get richer" mechanism is behind the frequently assumed situation where a country maintains a leadership position given an advantageous starting position. The "rich get richer" phenomenon is also behind the first-mover advantage. This concept is often used to explain a company's ability to be in a better situation than its competitors by being the first to arrive. This concept easily applies to the international economic system and explains why hardly any changes in leadership and hegemony occur. The "fit get richer" mechanism explains that a country that previously did not accumulate power or relevance can occasionally achieve a leadership position.

This dynamic analysis can provide information about the likelihood of a country's growth from the periphery to the core and whether the US' leadership position guarantees its persistence. The study of international interactions may reveal unequal power distribution among international actors. International economic networks tend to be asymmetric, which hinders change or alteration of the network.

Based on the General Temporal (GT) model framework, Pham et al. (2015, 2016) developed a model called PAFit (Preferential Attachment + Node Fitness) that allows for structural and dynamic analysis of hegemony. This model studies the growth patterns of a network and suggests the conditions required for an actor to increase its relevance in the network in the future. For instance, the network as a whole can reward each actor's previous leadership position in the network ("rich get richer"), or actors can boost themselves through their excellent individual performance regardless of their previous positions ("fit get richer").

Formally, preferential attachment in the context of the PAFit model states that the probability P_i of a country i to obtain a new link (patent or money) in a foreign country in the future is proportional to a positive function A_{ki} of the current weight of its links $k_i(t)$ at time t. This function is the preferential attachment function (Pham et al., 2015, 2016). If A_{ki} is an increasing function (on average), the 'the rich get richer' phenomenon exists, and a country with many patents will establish more links than a country with few links (Pham et al., 2016). Thus, there is preferential attachment if A_k is an increasing function on average (Pham et al., 2015 & 2016). The preferential attachment function is often assumed to have a log-linear form of the kind k^α. 'The rich get richer' phenomenon exists if $\alpha > 0$. The node fitness mechanism (or fitness of a country) in the PAFit model explains the probability $P_i(t)$ that a country i acquires a new connection depending on a positive number η_i. The quantity η_i is the fitness of the country i and can be interpreted as its intrinsic attractiveness. This mechanism explains the variations in connection capabilities between countries of the same degree, i.e., with the same characteristics (Pham et al., 2015, 2016). For example, two countries with approximately the same number of links at one point may acquire different links in the future based on their intrinsic features, such as their GDP (Pham et al., 2015, 2016).

The GT model allows for the interaction between agency (individual features) and structure (of the network) (Pham et al., 2020; Winecoff, 2020). The GT model applied to our case defines the probability of a country, with k links recognized during a specific year, to register a new link as:

$$P_i(t) \propto A_{k_i}(t) \times \eta_i \qquad (1)$$

If the distribution of connections in a network is sufficiently unequal, changes in countries' relative fitness may not be sufficient to alter the system's structure. For example, an increase in China's GDP may not imply a change in the distribution of power in the network, as a preferential attachment can be a very powerful force. As the network grows, its core countries become more entrenched, and the centrality of the network increases as it attracts more connections, allowing the countries constituting the core to gain more significant influence in the network.

Suppose an initial fitness advantage is reversed because of some nodes' ability to develop internally faster than the old core or because the core chooses to sever its connections with others, reducing the iterative power of preferential attachment. In that case, the old core may decline while a new core emerges. This fact has substantial implications when interpreting the central position of a country as a sign of hegemony; it could represent a change in the leadership position in the network. To break the preferential attachment dynamic, a country should improve its individual attributes by a large extent or for a long time, i.e., $\eta_i > \eta_j$. This is often difficult to achieve since ex-ante structural salience generates rewards that can be reinvested in fitness by the incumbent while preferential attachment continues to grow and strengthen.

The instrument used to identify the existence and weight of these two mechanisms in the evolution of the network is the estimation of the preferential attachment function

and node fitness with the PAFit (node fitness + preferential attachment) statistical method (Pham et al., 2020). The PAFit method can simultaneously estimate preferential attachment and node fitness with a Bayesian approach by formulating an estimation problem as the maximization of the log-likelihood function of a model with suitably added regularization terms to avoid overfitting (Pham et al., 2016). In formal terms, the PAFit function combines the log-likelihood of the model defined in Eq. (1) and two regularization terms.

The weight estimation of the two mechanisms in the PAFit framework works as follows: A preferential attachment function shared by all countries is estimated, while country fitness represents the additional attractiveness of each country that is not captured by preferential attachment (Pham et al., 2015, 2016). Joint estimation is done by observing how countries capture new patents at each time step.

Adapting the method of Inoue et al. (2020), it is possible to calculate which effect (preferential attachment or fitness) has more weight on network growth. This means estimating which effect pushes network growth: "the rich get richer" or "the fit get richer." For this purpose, we use the standard deviations (s.d.) of each year's logarithms of the preferential attachment and fitness values (Inoue et al., 2020). A considerable s.d. value of preferential attachment means that the "the rich get richer" effect plays a vital role in the network growth for each year. The same applies to the s.d. of fitness, as a significant value would indicate that the "the fit get richer" effect weights network growth. We observe which of the two effects has had a more significant weight over the entire period by comparing the s.d. values (Inoue et al., 2020).

Finally, in our methodology, we perform a simulation analysis to ensure the robustness of the results we have obtained. This analysis verifies whether our estimates and predictions are consistent when tested with simulated data. We employed the PAFit

model to simulate creating 100 different networks. In each simulation, the networks are generated from our initial estimates of what we consider to be proper network growth functions. The simulations are designed to reflect, as closely as possible, the characteristics observed in the real network we are studying. This means that we mimic the initial structure of the entire network, such as its initial layout and connections, and repeat the process we observe of creating new nodes and connections at each time step. These simulations allow us to observe how our estimates behave in various situations and whether these estimates are consistent and robust across the 100 simulated networks. Through this process, we can be confident that our results are reliable and represent what might occur in the real network.

To effectively integrate the perspectives of individual actors and the system's overall structure, we will focus on the structural and dynamic analysis of technology and finance, given their fundamental role as key drivers of the global economy and their far-reaching implications for other dimensions of economic hegemony. Technology and finance are intrinsically interconnected with other areas of economic hegemony, such as productivity and trade, and have a transformative impact on overall economic development.

In this way, we can integrate both views of power and observe whether structural relationships are as meaningful or more important than individual units' attributes in determining outcomes (Hafner-Burton et al., 2009).

These sectors, characterized by rapid innovation, digitization, and increasing interdependence among nations, represent the cutting edge of the 21st-century economy. Consequently, the analysis of technology and finance will provide insight into how the dynamics of economic hegemony are evolving and what factors are shaping the future balance of power.

Moreover, technological and financial dominance are significant elements of power projection in the modern world. A nation's ability to lead in technological innovation and maintain a solid financial system influences its ability to exert influence and set norms in the international arena. By focusing on these areas, we can better understand the mechanisms through which hegemonic powers assert their dominance.

Thus, the decision to focus the structural analysis on technology and finance is based on their central role in the global economy, their interconnectedness with other dimensions of economic hegemony, and their importance in power projection. This approach will allow us to indirectly capture the effects on other dimensions and provide a global understanding of US and Chinese economic hegemony.

In summary, we construct our methodology in three phases.

Phase 1: We apply static-individual analysis of the US and China, comparing the material capabilities of both nations.

Phase 2: We applied the static-structural analysis in the technological and financial area, analyzing the weight of each country in the network and its position of centrality.

Phase 3: We applied the dynamic-structural analysis in the technological and financial area, studying the dynamics of network growth: fit get richer or rich get richer.

2.4. Conclusions

This chapter has addressed four main objectives. First, it has sought to provide a comprehensive definition of the notion of hegemony. In this sense, economic hegemony has been understood as the capacity of a country (or group of countries) to exercise

leadership and establish norms in the international economic sphere, encompassing aspects such as trade, technology, finance, and production. Beyond this initial definition, we have highlighted a broad academic debate on the concept, its application, and the characteristics necessary for a country to be considered hegemonic.

The second objective has been to comprehensively review the academic literature covering the concept of economic hegemony. The origin of the concept of hegemony and its various theoretical approaches, such as realism, neorealism, HST, PTT, NI, SPT, WST, LCT, NGT, and NT, have been examined. In addition, the empirical approach to hegemony has been analyzed, highlighting how it has been measured and studied in the existing literature.

The third objective has been to make a theoretical synthesis of the different perspectives on hegemony, dividing between those focused on individual material capabilities and those focused on structure. A methodology has been developed to overcome the existing literature's limitations to study the dynamics and key factors influencing the possible hegemonic succession between China and the US.

Finally, a new methodology has been formulated to facilitate the study of potential hegemonic succession between China and the US. This three-level methodology – static-individual, static-structural, and dynamic-structural - will allow a more precise analysis of economic hegemony, comparing and evaluating its effects on specific outcomes. It will also provide a theoretical and methodological basis for analyzing other cases beyond the scope of this thesis.

Therefore, this chapter has contributed to the academic debate on economic hegemony and presented an innovative methodology to address the issue's complexity in the current context. With this methodology, it is hoped not only to better understand the hegemonic succession between China and the US but also to establish a framework that

can be applied to future studies and cases, enriching the existing literature in IR and IPE.

In this way, we fulfilled the first objective of this thesis which is to comprehensively review the existing literature to synthesize a cohesive theoretical framework concerning the concept of hegemony and develop a methodological framework to provide an in-depth understanding of the dynamics and critical factors influencing the possible hegemonic succession between China and the US and to facilitate the application of this framework at the empirical level.

In the second part of this thesis, an empirical analysis will be carried out applying the proposed methodology. This analysis will be carried out in two stages: first, by examining individual national capabilities, and then through a structural analysis of the global system.

First, China's economic rise will be analyzed (Chapter 3). A solid historical and economic context will be provided to understand China's growth as an emerging global power. China's economic growth model will be examined, identifying its strengths and weaknesses and its plans to transform the model, partly explaining the tensions with the US.

Second, in Chapter 4, we will apply the first phase of our methodology, static-individual, comparing the economies of China and the US, considering the individual material attributes of each country in four areas (productive, technological, financial, and commercial), using as a basis the theories of hegemony relations explained in the first section.

Third, in Chapter 5 and 6, two crucial aspects of hegemony will be addressed: technological and financial. The aim is to examine the economic power of China and the US from a structural and dynamic perspective, going beyond traditional bilateral approaches focused on quantifying the attributes of each country and complementing the

analysis of the second part of the thesis.

In the last part of the thesis, a global analysis will be carried out with the conclusions of each section, and the individual study will be compared with the structural dynamic study to answer the questions and test the hypotheses proposed in this work.

Thus, in the following chapters, what has been developed in this theoretical chapter will be applied in an empirical analysis. This will allow for a more detailed and applied study of the possible hegemonic succession between China and the US and provide a more complete and detailed analysis of global economic dynamics by delving into specific areas of economic influence and power, such as technology and finance. Ultimately, these chapters will complement and further enrich the contribution of this work to the field of IR and IPE.

3. THE RISE OF CHINA

ABSTRACT

This chapter analyzes the rise of the Chinese economy and its integration into the international system. To achieve this objective, we conduct a comprehensive literature review on the ascent of China and its implications for the international order. We examine the foundations of China's renowned "world's factory" and discuss its inherent limitations. Additionally, we study the government's objective of transitioning the production model towards one focused on domestic consumption and technological development. Lastly, we analyze China's plans to become a technological powerhouse and its projection in the global economy. By exploring these aspects, this chapter contributes to a deeper understanding of China's economic rise and its implications for the international arena.

3.1. Introduction

As mentioned in the previous chapters, the main objective of this thesis is to analyze whether China has the potential to replace the US as the hegemonic economic power in the current global system. In this third chapter, we will analyze China's economic rise in recent decades, its limits and strategies to transform its productive model, and its projection in the international arena. This analysis will serve as a starting point and foundation for addressing the objectives, questions, and hypotheses posed at the beginning of this paper (in Chapter 1) on the possible hegemonic succession between China and the US.

The debate surrounding the rise of China and its possible future as a hegemonic power is diverse and nuanced. Some scholars, such as Jacques (2008), Lee (2018), Mahbubani (2020), Dalio (2021), and Moyer et al. (2023), argue that China will overtake the US as a global power. On the other hand, there are several authors, including Brooks (2019), Norrlöf and Reich (2015), and Shambaugh (2018), who argue that China's global reach has substantial limitations, calling into question its readiness to assume the mantle of hegemonic power. These limitations include dependence on foreign technologies or the difficulty of translating technological development across the economy (Starrs, 2018; Liu & Tsai, 2020; Rikap & Lundvall, 2021; Ding, 2023; Schindowski & García-Herrero, 2023). On the other hand, there is a consensus among Mearsheimer (2014, 2019), Pillsbury (2015), Allison (2017), LCT theorists, and Friedberg (2020) that the rise of China threatens US hegemony and could incite a war of supremacy.

To contribute to the above discussion, Chapter 3 provides an analysis of China's economic rise and transformation, both internally and in its international projection, serving as a basis and context to answer the critical question of this thesis, which is to

analyze whether it can surpass the US as a hegemonic power in Chapter 4, 5, and 6 if it can replace the US.

Since China began implementing its economic reforms in 1978, it has successfully transitioned from a closed, centrally planned economy to a more market-oriented one, earning the name "the world's factory." High savings and investment rates have driven this transformation, with a focus on low-value-added exports and an abundant supply of cheap labor (Molero-Simarro, 2014; Lo, 2018). Over the past four decades, China has experienced rapid economic growth, lifting millions of its citizens out of poverty and propelling the nation to become a significant player in the global economy (Vázquez, 2022). As a result of these remarkable achievements, China has recently become the world's largest economy in terms of GDP measured by purchasing power parity (PPP) (Li, 2020). This milestone marks a significant shift in the balance of economic power, with China surpassing the US by this measure. The rise of China as the world's largest economy in GDP PPP terms demonstrates the effectiveness of its "world factory" model, which has enabled the nation to capitalize on its comparative advantages and establish itself as a dominant force in the international economic landscape.

However, in the latter part of Hu Jintao's term (2003-2013), Chinese authorities acknowledged the model's limits, which included dependence on low value-added exports and investment, rising inequality and low consumption, demographic challenges as population growth reached a ceiling, overcapacity issues and a real estate bubble (Molero-Simarro, 2014, 2017; Wagner, 2019; Li, 2020; Vázquez, 2022; García-Herrero, 2022). Consequently, they promoted a shift toward the tertiarization of the economy, technological development, and increased domestic consumption. With the arrival of Xi Jinping, China has adopted a more active role abroad, evidenced by initiatives such as the Belt and Road (Vázquez, 2022). To address these challenges, China's new economic

model is centered on several key objectives: transitioning from an extension to a more intensive growth model by improving disposable income for Chinese citizens while reducing inequality, relying more on consumption than investment, achieving technological autonomy, climbing the global value chain and leading in critical areas of the fourth industrial revolution and enhancing China's role on the international stage (Vázquez, 2022).

Nonetheless, the shift faces challenges internally, such as reliance on high levels of investment as a percentage of GDP and low consumption due to the low-income share of Chinese households and high inequality (Molero-Simarro, 2017; Klein & Pettis, 2020) and externally, such as tensions with global powers like the US. Nevertheless, since the start of the Trump Administration in 2017, tensions between China and the US have intensified, with Washington pursuing a containment strategy to curb China's technological rise. This strategy has continued under the Biden Administration, as China's ambitions to become a technological superpower have significantly disrupted the international order. The US perceives China's advances in 5G, artificial intelligence, and other cutting-edge technologies as a direct threat to its global hegemony and national security (Vázquez, 2022). China must overcome these obstacles, both internal and external, to successfully transition to a more sustainable and globally influential economic model (Vázquez, 2022).

In this vein, the ongoing rivalry between the US and China has led to a technological arms race (Sullivan, 2022). The US has employed strategies to curb China's ascent, including a technology blockade targeting crucial industries like semiconductor manufacturing. In response to this evolving landscape, the Biden administration has established a state strategy focused on containing China's technological rise and maintaining US hegemony in the long term. National Security Advisor, Jake Sullivan,

has outlined this strategy, emphasizing the need to integrate economic policy and foreign policy while defining objectives and measures to compete with China in critical areas for the future. Sullivan has stated that the US must stay several generations ahead of China in crucial technologies such as artificial intelligence, biotechnology, clean energy, cybersecurity, and space (Sullivan, 2022). To achieve this, Sullivan has proposed a comprehensive approach that includes investing in science and technology, nurturing the best STEM talents, protecting technological advantages, and deepening and integrating alliances and partnerships. Through these measures, the US aims to reinforce its position as the dominant global technological power and counteract China's growing influence in this domain (Sullivan, 2022). This global approach to the US-China rivalry highlights the relevance of the hegemony issue.

In summary, this chapter shows how despite its remarkable progression and rise in global value chains, China's economic rebalancing needs to be more consistent, partly due to its reliance on high levels of investment and limited household consumption due to its domestic economic inequality. In turn, China's technological advances and growing international influence, underscored by initiatives such as the BRI and the AIIB, have triggered a response from the US, which perceives China's rise as a threat to its dominance. This dynamic has instigated a technology war, with both nations vying for leadership in Fourth Industrial Revolution technologies such as 5G and AI. Despite the looming challenges, China's rapid economic expansion suggests that its rise may reshape the global economic balance of power.

The rest of the chapter is structured as follows: Section 3.2 provides a literature review on China's rise, contextualizing the debate over its potential as a hegemonic power. Section 3.3 explores the evolution of China's economy, examining the creation and development of the "world factory," its limitations, and the potential shift in the

growth model, including the property bubble in China.

Section 3.4 delves into China's transition from a global factory to a technological powerhouse, analyzing key components such as standards, artificial intelligence, 5G technology, semiconductors, and the energy transition. Section 3.5 scrutinizes China's role in the international arena, underscoring its advancements in various areas.

Finally, Section 3.6 presents the concluding remarks, summarizing key findings and discussing the implications for the scholarly debate surrounding China's ascent and its potential as a hegemonic force in the global system.

3.2. A literature review on China's rise

In recent decades, China's rise has sparked extensive debate regarding its consequences for the rest of the world and its role in the international system, mainly whether it could replace the US as the hegemonic power. This section reviews the literature on China's rise, its impact on the global economy, and the existing balance of power.

Authors such as Baldwin (2016) emphasize that globalization has leveled the economic playing field between developed and developing nations, highlighting the emergence of Asia and China as the new global economic epicenter. Jacques (2008), Mahbubani (2020), and Moyer et al. (2023) go a step further, suggesting that this phenomenon could lead to China becoming a hegemonic power soon. Similarly, Lee (2018) underscores China's leadership in disruptive technologies, such as artificial intelligence, which could propel the country to the top world power. Xuetong (2019, 2020) argues that technological superiority, especially in the digital realm, is crucial to the strategic competition between China and the US. Furthermore, he contends that the convergence of the new digital era and the Cold War mentality is shaping the emerging international order.

Additionally, focusing on the technological domain, Rikap and Lundvall (2021) investigate the competition between the US and China in innovation, specifically within AI and digital services. While China has exhibited remarkable economic growth and substantial investments in research and development, it continues to confront challenges related to acquiring AI talent, addressing human rights concerns, and ensuring freedom of speech. The authors emphasize the intricate and uncertain nature of the global innovation competition, stressing that although China has made significant progress, it is not a foregone conclusion that it will emerge as the next hegemonic power. However, although China has yet to surpass the US, for Malkin (2020) and Rikap and Lundvall (2021), China represents a potential threat to the US hegemony in the global economy due to its growing structural power in areas such as intellectual property protection, the GVC, asset ownership, and the definition of technological standards (Malkin, 2020; Rikap & Lundvall, 2021).

However, Ding (2023) contradicts many arguments regarding China's potential and contends that claims about China being on the verge of becoming a scientific and technological superpower are unfounded due to a diffusion deficit. Ding (2023) posits that assessments focusing solely on innovation capacity overlook a country's ability to disseminate or widely adopt innovations. The author argues that a divergence between a rising power's innovation and diffusion capabilities leads to imbalanced evaluations of its potential to sustain long-term economic growth. In contrast to other studies that predict China will inevitably surpass the US as a hegemonic power, particularly in the technological domain, Ding (2023) emphasizes the importance of considering China's diffusion capacity before making claims about its potential to outstrip the US in scientific and technological capabilities.

Similarly, Schindowski and García-Herrero (2023) argue that the future of China's

economy hinges on its innovation efforts to counter the structural deceleration of its economy. They acknowledge the country's achievements in increasing inputs to innovation, such as research and development and improved human capital, and the rise in the quantity and quality of scientific publications and patents. However, they question whether these advancements will slow or reverse the deceleration of China's total factor productivity, which has recently underperformed compared to other emerging economies with similar per capita incomes. For these authors, there are three potential bottlenecks to productivity growth identified: the institutions' role in innovation, with government collusion possibly leading to the misallocation of resources; societal changes and institutional barriers deterring younger generations from innovative pursuits; and US containment of China's technological advancements, particularly in semiconductors, hindering Chinese firms' access to critical technologies.

Hung (2015) maintains that China is far from overtaking the US as the Chinese economy grapples with structural challenges like social inequality, public and private debt, export dependency, and competition from other emerging nations. Similarly, Liu and Tsai (2020) contend that China lacks the necessary structural conditions to become a hegemonic power in the global capitalist system. Its economic power is limited and relies on external factors.

From a more economic perspective, Pettis (2013) and Klein and Pettis (2020) also express skepticism regarding China surpassing the US economically, citing the nation's economic and financial challenges. Pettis argues that China needs economic imbalances that could impact its future growth, such as high levels of investment, low consumption propensity, and increasing indebtedness, which may hinder long-term development unless addressed through substantial structural reforms.

Lo (2018, 2020) provides an interlinked perspective on the Chinese economy, its

development, and its systemic global impact. On the one hand, in his 2018 work, Lo argues that the recent stagnation in China is attributable to both demand deficiency and profitability decline, which are deeply rooted in the prevailing structural-institutional conditions and internally divisive state orientation. He identifies a rivalry between two alternative directions for Chinese economic transformation: convergence to the Golden Age Model and a tendency towards economic financialization. From this observation, Lo suggests that the predominance of a speculation-oriented model has accounted mainly for the recent economic problems that have emerged in China. On the other hand, Lo (2020) studies critically appraises the systemic impact of China on global development, focusing on industrialization and labor conditions in the developing world. Unlike existing studies on market competition, Lo underscores the significance of productive investment. He counters the prevalent theses of China reinforcing Southern de-industrialization and undercutting Southern labor, arguing instead that China has driven its trade expansion through productivity growth rather than cheap labor. Both of Lo's works present the Chinese economy as a counterbalance to the predominance of speculative finance under neoliberal globalization, promoting productive investment and serving as a brake on destabilizing trends in the global economy.

From a different perspective but with a similar conclusion, Ikenberry (2014) contends that China will not manage to dethrone the US as the hegemonic leader of the international order. Instead, both countries must adapt to a new balance of power based on collaboration and multilateralism. Nye (2020) emphasizes that economic power is only one of the factors to be analyzed when studying the possible succession between China and the US. Although China may surpass the US in terms of total economic size, its GDP per capita remains lower. Moreover, China lags behind the US in aspects such as military power and cultural influence (soft power).

Nye (2017, 2020) also examines the relevance of China's growth in its integration into the international liberal order and its ability to provide global public goods. However, China is likely to behave as a free rider, just as the US did in the 1930s. While China and other countries may be unable to disengage from interdependence with the US in the short term, the incentives will grow in the long run. This could weaken international institutions that help resolve conflicts and promote global public goods. Along similar lines, Brooks (2019) argues that historical power transitions are not relevant for understanding China's rise and that focusing on GDP as an indicator leads to misguided interpretations.

From the neorealist perspective, authors such as Mearsheimer (2014, 2019), Pillsbury (2015), Allison (2017), and Friedberg (2020) argue that China's rise threatens US hegemony and could trigger a war for supremacy. Mearsheimer (2014, 2019) points out that China's growth implies a transformation of the international balance that endangers US hegemony and increases the likelihood of armed conflict. Similarly, Allison (2017) introduces the idea of the Thucydides Trap, which posits the apparent inevitability of war when an emerging power challenges the dominant power. However, Allison also emphasizes that war can be averted, though the risk remains. Pillsbury (2015) claims that China's strategy aims to surpass the US, while Sendagorta (2020) maintains that China aims to modify the international order, supporting marginalized countries and seeking to convert its economic power into political influence.

Norrlöf and Reich (2015) argue that China has played a crucial role in stabilizing the global economic system over the last decade. They present empirical evidence demonstrating how China has contributed as a lender of last resort, provider of international liquidity, and manager of aggregate demand during the global financial crisis. Furthermore, they suggest that China could gain greater relevance as a provider of global public goods in the future. These stabilizing functions, described by Kindleberger

(1973), are the responsibilities an economic leader must assume to ensure order and stability in the international economic system. Specifically, Kindleberger's functions are: ensuring international markets are accessible and open, offering loans to countries in need, supplying international liquidity during shortages, coordinating macroeconomic policies among nations, and settling international economic disputes. The author contends that the international economic system is a global public good requiring the intervention of a hegemonic leader.

On the other hand, Shambaugh (2018) argues that despite China's rapid economic growth in recent decades, the country still needs to improve its global projection. According to Shambaugh, China is considered a partial power due to the absence of a crisp strategic vision and a cohesive global agenda. The author also argues that China does not exert considerable ideological or cultural influence on other nations and does not lead or participate fully in international institutions and norms. Furthermore, Shambaugh emphasizes that China needs loyal allies and long-term strategic partners and needs to project an attractive or positive image in the international arena, which limits its potential as a hegemon.

Bonnie Glaser (2019) argues that China, rather than pushing for sudden global changes that could affect political and economic stability, selectively write new rules and develop new norms, promoting incremental change in the international order. According to the author, China establishes parallel institutions when it perceives the current ones are not working in its favor. Similarly, Ward (2019) argues that China is implementing a long-term strategy to achieve global leadership, seeking to undermine the US influence and weaken the US-led global architecture. The author examines how China accomplishes this through various activities, such as investing in foreign technology and companies, building a global infrastructure network, and promoting alternative values to

Western ones. In this line, Beeson and Li (2016), Doğan (2021), and Gao (2023) suggest that China seeks and has the potential to create a new international economic order through new institutions, such as the AIIB and the BRI project for China-centered international trade and investment (Beeson & Li, 2016; Gao, 2023). In this regard, Doğan (2021) argues that China's historical relationship with neighboring countries through the Tribute System can be compared to the country's current foreign policy. China has sought to strengthen its military and economic power. Although it has denied its intention to establish hegemony worldwide, history shows that China's relationship with its neighbors has been based on its power. The Silk Road initiative is designed to convert economic power into political power. The author suggests that, because of its focus on power accumulation and China's historical background in its relations with neighbors, it may be possible for China to become a future hegemonic power (Doğan, 2021).

Another debate on China's role has been generated around WST and the work of Giovanni Arrighi (2007). Arrighi argues that the hegemony of the US has been in decline since the 1970s and that the characteristics of the Chinese economy make its rise different from that of other hegemonic aspirants. Thus, the Chinese model would not be a fully capitalist economy since it does not follow a logic of profitability at the level of other Western economies. It also has had an introverted idiosyncrasy throughout its history, achieving links based on trade that slowed down military expansions. These factors would allow for avoiding a conflictive hegemonic succession, sharing China's economic power with the US's military power in a new peaceful international order, which would confront the authors linked to the Thucydides trap mentioned above. Furthermore, the increase in social conflict in China and the growing redistributive demands would slow down imperialist expansion (Arrighi, 2007).

Arrighi's thesis generated a broad debate on the rise of China (Molero-Simarro,

2016). On the one hand, Panitch and Gindin (2013) and Fusaro (2019) consider that Arrighi's thesis was wrong since US hegemony was not in decline in the 1970s, as the rivals pointed out by Arrighi (Germany and Japan) were allies that helped shore up that hegemony. However, Fusaro points out that the case of China is different from that of Germany and Japan since this country has some geopolitical autonomy and is indeed a capitalist economy that is creating its hegemonic order with initiatives such as the BRI (Fusaro, 2019). Similarly, authors such as Pradella (2010) and Katz (2011) opposed Arrighi's "pacifist" argument, pointing out that the growth of market relations and the logic of profitability in the Chinese economy would lead to imperialist expansion, as in other historical cases such as the 1930s. In contrast to Arrighi (2007), Ho Fung-Hung (2015) argues that China will never be a hegemonic power like the US. According to Hung, the growth of the literature on China's rise is the reverse of that of the 1970s that asserted American decline. However, despite the change in the global correlation of forces, China has contributed to global neoliberalism, and its export model is highly dependent on the West, so it will not alter the world order, as it would slow down its expansion. In addition, Hung points out that China faces the limits of its growth model based on high investment rates and loss-making financing of its state-owned enterprises to meet government targets. This model is highly dependent on the dollar, making it a guarantor of the current system. Finally, Hung argues that China has a poor relationship with its neighbors, despite strong economic ties, implying a significant US presence in the region and solid historical allies that will never bow to China.

Molero-Simarro (2016) questions Arrighi's argument that China can maintain its peaceful rise amid internal governance problems. According to Molero-Simarro, this situation may lead China to externalize internal contradictions to contain social conflicts. This argument would be supported by projects such as the BRI, which coincide with an

increase in the assertiveness of Chinese economic diplomacy and an attempt to offshore excess capacity and expand foreign markets (Fusaro, 2019). Other authors linked to WST, such as Minqi Li (2008, 2016) or Li and Zhang (2018), argue that China's rise verifies the functioning of historical hegemonic cycles and indicates room for maneuvering within the system. For Li and Zhang (2018), if China were to lead the world system, it would only reflect its internal extension without altering the architecture of the global capitalist system. Minqi Li (2008 and 2016) states that the American cycle is the last of the modern world system because of its geographical expansion limits. According to Minqi Li (2016), the key would be in the geological and energetic limits of the planet, which would not allow a new expansion based on fossil fuels centered in China.

In this line, China can be considered a semi-peripheral country in the world system (Li, 2021). According to the "center-periphery" and "center-semi-periphery-periphery" theories, China's tremendous growth distinguishes it from the countries of the periphery or "semi-periphery" (Cheng, 2021). While a gap still exists between China and the major countries at the center of the world economic system, China's increasing economic power and influence make it a "quasi-center" in the world economic system (Cheng, 2021). China's BRI seems to possess the qualities of a new world system in the making, within which China enjoys hegemonic traits such as economic and military might and capable alternative institutions (Sarieddine, 2021). However, China has not become a core power (Sarieddine, 2021). According to Zhao (2021), China is a semi-peripheral power that has increased its share in the international market but is still in a subordinate position concerning the world economy's core. Therefore, based on the provided research results, China can be considered a semi-peripheral country in the world system (Li, 2021).

Rolf (2021) approaches China's rise from the perspective of uneven and combined development, a theory that holds that world capitalism as a unitary system exists

according to a general condition of uneven and combined development: persistent changes in the geography of global economic development inevitably generate geopolitical tensions by empowering some states economically and militarily at the expense of others. In this framework, China's rapid growth, driven by geopolitical threats, has mobilized its state apparatus to acquire technological and economic materials from advanced economies, allowing it to leapfrog stages of development and pursue accelerated economic growth. This strategy has created significant social and geographic imbalances and resulted in a "state capitalist system of accumulation" after the 2008 economic crisis. Rolf argues that the rise of China will have a significant impact on the world system in the next decade, not only reconfiguring its position within the US-dominated global political economy but also influencing future forms of uneven and combined development in the states that follow its trajectory.

From another approach, the TCL has analyzed the rise of China as the beginning of the new K-wave (Kondratieff's), which implies a reconfiguration of the world system that may last between ten and twenty years (Grinin & Korotayev, 2015; Grinin et al., 2017). According to these authors, this reconfiguration results from the convergence between East and West, which hinders US hegemony. Moreover, political globalization lags far behind economic globalization, and their equalization will imply a new world political order without an absolute leader to replace the US or China. This may increase instability and the US's actions to preserve its leadership by soft and hard means (Grinin et al., 2017; Thompson, 2020).

Although from a different framework, Dalio (2021) explores the historical cycles of the rise and fall of great empires. According to the author, we are witnessing the decline of the US and the rise of China as a dominant power in an "archetypal Great Cycle," which involves a phase of leadership and peaceful growth, followed by a loss of

competitiveness and productivity, and finally a period of decline. The author suggests that the current "signs" prelude the consecration of the new world power.

Cooley and Nexon (2020) argue that the decline of the US is due to the fact that other alternatives, such as China or Russia, reconfigure the hegemonic order. These countries have launched alternative institutions and projects such as the NDB, the BRI, or the AIIB. However, these countries are not a counter-hegemonic bloc because they have bad historical relations, it is in their interest to maintain the US-led international liberal order, and they are not strong enough to change it. Therefore, if the US maintains the international liberal order structure, it will maintain its hegemony.

From a neo-Gramscian perspective, Xing and Zhang (2018) argue that the rise of China will generate tension, struggle, and adjustment with the dominant forces of the current world order. This is because a more horizontal order creates more spaces for interaction and competition, with opportunities and challenges. China's strategy is a gradual and protracted political struggle to weaken the influence and foundations of the existing power structure rather than confrontation. This strategy is reflected in Beijing's strategic plans, such as Made in China 2025 (MIC2025), the Asian Infrastructure Investment Bank or the BRI, which seek to occupy a central position in global governance as a new and alternative provider of global financial public goods. Thus, China is becoming an emerging rule maker to set norms and standards (Xing & Zhang, 2018).

In summary, there is a part of the literature defends the possibility that China may be the next hegemonic power, such as TCL theorists, Dalio (2021), or that this country may be a clear candidate for succession, such as neo-Realysts authors and that there is a significant risk of conflict between the two. This is also argued by WST authors who criticize the pacifist thesis of Arrighi (2007), although they argue that China's non-peaceful expansion will have to do with its internal contradictions. Other authors, like

Arrighi, point out that we may be moving towards a world with two great powers or, as Xuetong points out, a new cold war. On the contrary, authors such as Ikenberry (2014), Klein and Pettis (2020), and Hung (2015) affirm that China will not be the first world power.

In order to shed light on this debate, we will analyze China's rise, studying its growth patterns over the last decades, the limits and contradictions of its model, and its pretensions to transform it into one more oriented towards domestic consumption, technological development, and international projection. This will be followed by a comparison between the individual material capabilities of China and the US in four areas: productive, technological, commercial, and financial.

3.3. Evolution of China's economy

3.3.1. Building the world's factory

China was the world's largest economy until the 19th century, accounting for up to 25% of global output between 1500 and 1820 (Li, 2020). However, after falling behind in the Industrial Revolution and suffering several military and political defeats to foreign powers, it entered a "Century of humiliation" (1839-1949) (Doğan, 2021), losing its international status and experiencing some of the highest levels of poverty in the world (Vázquez, 2022). China's per capita GDP relative to the world average fell from 61% in 1870 to 21% in 1950 (Li, 2020).

The victory of the Chinese Communist Party (CCP) in the Civil War in 1949 ended the so-called "Century of Humiliation." In the first thirty years of the People's Republic of China (PRC), a Soviet-style planned socialist economy was formed, agrarian property was collectivized, and the country achieved rapid industrialization (Molero-

Simarro, 2014; Vázquez, 2022). Thus, despite the turmoil caused by the Great Leap Forward and the Cultural Revolution, the strong decline of the country was reversed, laying the foundations for a great expansion in the following decades of reform (Li, 2020; Doğan, 2021). In the Maoist era (1952-1978), the Chinese economy grew at an average annual rate of 4.4%, and GDP per capita grew at an average annual rate of 2.3%, doubling per capita income in 30 years (Li, 2020).

Following the establishment of the People's Republic of China (PRC) in 1949, the country remained isolated from the world capitalist system for three decades. However, in the late 1970s, the Chinese authorities decided to open up to the outside world and boost economic growth for both economic and geopolitical reasons, seeking to improve their position in the international order (Molero-Simarro, 2014; Li, 2020; Doğan, 2021). To achieve this goal, China needed to access Western technology that would enable it to reduce the development gap with its East Asian neighbors, such as Japan, South Korea, and Taiwan, which had achieved a high level of industrialization and modernization thanks to the adoption of advanced technologies. China, on the other hand, had lagged behind due to its isolation from the world capitalist system for three decades, and its economy was mainly based on agriculture and heavy industry. In order to access Western technologies that would allow it to improve its productivity, innovation, and competitiveness, China had to open up to international trade and attract foreign investments. But to do so, it had to offer something in exchange to the world capitalist market, and that was its cheap and abundant labor force, which enabled it to produce low-cost goods and export them to the rest of the world (Li, 2020). Thus, China became the "world's factory" but depended on Western technology to advance its development. The Chinese authorities reformed their planned socialist economy by gradually introducing elements of a market economy. The reform aimed to address the contradictions of the

centralized planning model, which ensured the equal distribution of surplus but hindered productivity expansion (Molero-Simarro, 2014). The goal was to maximize economic growth to catch up with Western countries without considering potential negative consequences such as regional and environmental social inequality. Deng Xiaoping's strategy focused on making China the "world's factory," allowing for rapid and inexpensive incorporation of technical knowledge and closing the technological gap with the rest of the world (Wagner, 2019).

Since the 1980s, China has initiated the opening up to foreign investment, price liberalization, and partial deregulation of the economy. The creation of private companies was allowed, and competition was stimulated in sectors previously controlled by the state (Molero-Simarro, 2014; Li, 2020; Vázquez, 2022). Additionally, agricultural production was privatized, and farmers were given the ability to make decisions about their lands and crops and have ownership of their production. This increased efficiency and economic growth in the sector (Molero-Simarro, 2014). In addition, another key transformation was the establishment of Special Economic Zones (SEZ), attractive centers for Foreign Direct Investment (FDI) for foreign multinational companies, given the potential of the domestic market and low wages. This served as a basis for the Chinese government to negotiate better terms for technology transfer (Rikap, 2021). Historically, innovation policy was predominantly based on imitation and adaptation through technology transfer and reverse engineering until the late 20th century (Delgado-Ramos, 2007; Rikap, 2021). Typically, these were joint ventures in which foreign firms were mandated to collaborate with Chinese firms, thus enhancing the technological capabilities of domestic corporations, both state-owned and private (Durand & Milberg, 2020; Rikap, 2021).

During the 1990s, reforms included the privatization of most small and medium-sized state-owned enterprises, resulting in the elimination of tens of millions of jobs. In

total, more than 80% of the 1998 SOEs were closed or privatized by 2007 (Hsieh & Song, 2015), and the new private enterprises adopted a profit maximization approach (Milanović, 2019). The intention was to improve efficiency and productivity, but it also significantly affected state workers, who were massively unemployed (Li, 2020). Moreover, the government's decision to control agricultural prices worsened living conditions in the countryside and motivated continued migration to urban areas (Molero-Simarro, 2014). Thus, millions of internal migrant workers replaced the laid-off labor force (Li, 2020). These workers maintained their official residence in rural areas but worked mainly in cities, lacking social and labor rights as they had no official residence (Molero-Simarro, 2014; Li, 2020). This lack of rights, combined with an increase in cheap labor in the cities, led to a reduction in labor costs below productivity, resulting in higher profits for firms and increased investment in productive capital (Molero-Simarro, 2014; Klein & Pettis, 2020; Li, 2020). Despite privatization and the commoditization of the economy, the state retained a significant role in the development of Chinese technology (Weber, 2021) and invested in research and development (R&D), especially in strategic sectors such as aerospace, defense, telecommunications, and biotechnology (Rikap & Lundvall, 2021). The state also supported private companies by providing them with subsidies, tax incentives, preferential loans, and protection from foreign competition (Rikap & Lundvall, 2021). In addition, the state encouraged cooperation between public research institutes and private firms, as well as between domestic and foreign firms, to facilitate technology transfer and innovation (Wagner, 2019; Doğan, 2021).

According to Li (2017), Chinese wages represented between 10 and 25% of those of Americans with the same qualifications. This accelerated the process of offshoring for multinational companies and increased foreign direct investment during the peak of globalization. China's entry into the World Trade Organization in 2001 was the definitive

turning point after which the Asian country became the world's leading trading power (Vázquez, 2022). This process also increased the transfer of technology by transnational companies and contributed to increasing productivity. Combined with the continuous depreciation of the yuan until 2005, it made the Chinese economy highly competitive in international markets (Molero-Simarro, 2016). This phenomenon, along with the need to expand urban areas with infrastructure investment (Fiorito, 2013), directed the Chinese model toward high investment rates and an increase in low-value-added exports (Qi, 2018; Gerig, 2019; Klein & Pettis, 2020). China's GDP grew by an average of 10% annually between 1980 and 2007, mainly based on labor cost contraction and high investment rates financed by high corporate profits (Molero-Simarro, 2014). In 2000, the reforms toward a market economy were already bearing fruit. State-owned industrial enterprises accounted for 50.2% of the total sales revenue of all industrial enterprises with annual sales income of 20 million yuan or more (Li, 2020). By 2010, the share of state-controlled enterprises sharply declined to 27.9% and 23.4% in 2017 (Li, 2020). Overall, despite the significant role of the state, the logic of profitability prevailed, and after three decades of market reforms, the Chinese economy had become a capitalist economy (Milanović, 2019), as industrial production, employment, and investment were driven by market forces (Vázquez, 2022).

As China's economy became more market-oriented and integrated into the world capitalist system, its growth model also experienced some structural transformations and encountered some imbalances and contradictions. Figure 1 shows the evolution of the economic pillars over time. In 2001, investment represented 35.5% of GDP, grew to 42.3% in 2008, and reached 42.83% in 2021, with a peak of 46.6% in 2010. On the other hand, trade started at 61.9% of GDP in 2001, declined to 57.61% in 2008, and stood at 54.2% in 2021, peaking in 2006 at 64.5%. The share of consumption fluctuated, falling

117

from 61.9% in 2001 to 49.77% in 2008, and increased to 54.3% in 2021, with its minimum in 2010 (48.9%). Finally, gross savings grew from 37.3% in 2001 to 51.78% in 2008 but declined to 44.9% in 2021, after peaking in 2008 (51.8%).

Figure 1. Weight of Gross capital formation, trade, gross savings and consumption as % of GDP
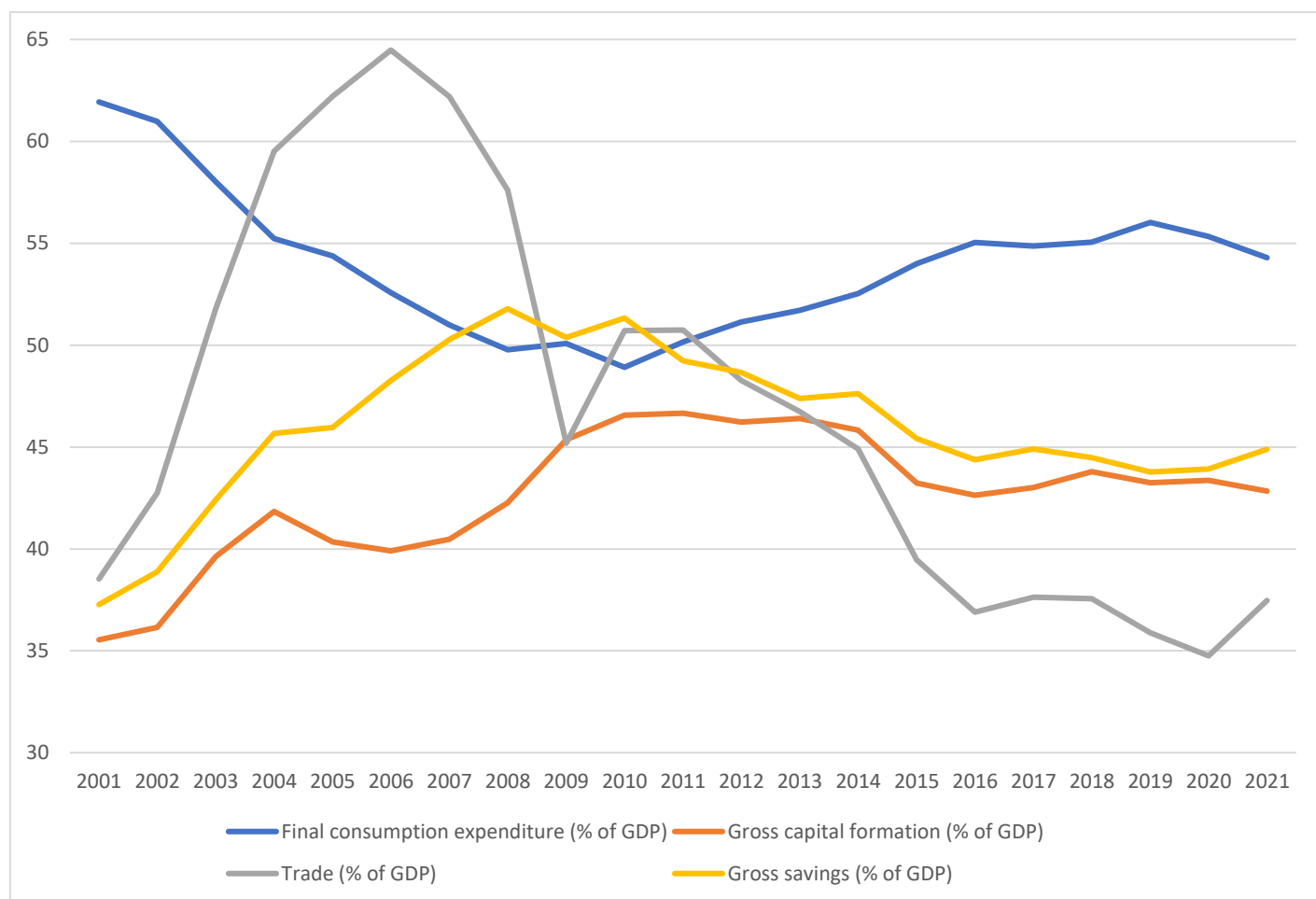
Source: World Bank (2023)

A comparison with other countries reveals that China's consumption, savings, and investment patterns are quite different from those of developed and developing economies. According to data from the World Bank, in terms of consumption as a percentage of GDP in 2021, China also compares with several Asian and BRICS countries. For example, in South Korea and Japan, consumption accounted for 64.3% and

75.3% of GDP, respectively, figures closer to China's but still higher. The BRICS countries also show similar patterns. In India, consumption was 70.7% of GDP, while in Brazil, Russia, and South Africa, consumption accounted for 80.1%, 67.8%, and 81.3% of GDP, respectively, all-surpassing China in terms of consumption as a percentage of GDP. Therefore, in terms of consumption, China shows a lower proportion compared to countries such as South Korea, Japan, India, Brazil, and Russia. This reinforces the idea that China's economy leans more towards investment and savings than consumption compared to these countries, which has implications for its economic structure, income distribution, and external balance.

The dynamics of the growth model continued to contribute to increased rural-urban inequality and inequality within urban areas (Molero-Simarro, 2017; Vázquez, 2022). However, poverty reduction has been continuous since the 1990s, with the percentage of the population living below the poverty line decreasing from 25% in 1990 to 3.9% in 2007 and 0.1% in 2016 (Vázquez, 2022). China's Gini coefficient increased steadily from 0.28 in 1983 to 0.49 in 2008 but then stabilized and began to decline to 0.46 in 2019 (Kanbur et al., 2020).

3.3.2. Limits on the world's factory model

In this section, we analyze the limits and challenges of the growth model based on high investment and exports that have characterized China's economic development in the last decades. Although this growth pattern has enabled China to become one of the world's leading economic and commercial powers and to surpass the US as the world's largest economy by purchasing power parity in 2014 (Li, 2020; Vázquez, 2022), it has also generated some problems such as high levels of pollution, social and regional inequality, overcapacity resulting from overinvestment or increasing total debt (Gaulard, 2015; Klein

& Pettis, 2020). Moreover, it is possible that the growth pattern itself is reaching its limits, running the risk of falling into the middle-income trap (Glawe & Wagner, 2017) or stagnating as a semi-peripheral power (Li, 2020), something that is recognized by the Chinese authorities (Pettis, 2013). This problem refers to countries that reach a certain economic level but begin to experience a sharp decline in economic growth rates due to losing competitive advantage in manufactured exports (Gaulard, 2015; Barredo-Zuriarrain & Molero-Simarro, 2018; Wagner, 2019). All this is in a context in which the purchasing power of the country's families has not yet developed sufficiently to compensate for the dependence on exports (Barredo-Zuriarrain & Molero-Simarro, 2018; Vázquez, 2022).

The country's major engines of growth have relied on the tens of millions of workers who migrated from the countryside to the cities to drive the mainland's industrial economy and the government's huge investments in factories, infrastructure, and machinery (World Bank, 2019). However, both population growth and the inflow of workers from rural areas seeking work in the city have slowed (Vázquez, 2022). In addition, investment levels are becoming less efficient, something that has an impact on productivity and GDP growth. In short, China's previous growth patterns are losing momentum (World Bank, 2019; García-Herrero, 2022; IMF, 2023). Currently, the imbalances in the model are largely due to high levels of investment and low levels of consumption, as shown in Figure 1 (Molero-Simarro, 2014; Wagner, 2019; Klein & Pettis, 2020; Vázquez, 2022). Specifically, for Klein and Pettis (2020) and Orlik (2020), high investment rates are unsustainable, as they generate increasingly lower returns (see Figure 2) and increase private and public debt. Specifically, China's private debt rose from 138.4% of GDP in 2010 to 193.6% of GDP in 2021 and public debt from 33.9% to 71.5%, respectively (IMF, 2023). In a similar vein, Gaulard (2018) points out that local

government intervention in state-owned enterprises produces reduced levels of profitability and encourages overinvestment.

Another indicator of the limits of the investment-driven growth model is the declining return on capital. According to data from the World Bank (2019), half of China's GDP growth since 1978 can be attributed to capital intensification, about a third to the increase in total factor productivity, and the rest to labor force growth and investments in human capital (World Bank, 2019). The contribution of total factor productivity has dramatically declined since the global financial crisis, dropping from 3.2 percentage points in the years preceding the crisis to 1.1 afterward, making growth rely more heavily on physical capital investment (World Bank, 2019). Moreover, China's investments now face diminishing returns, as they increasingly have less impact on growth, especially those related to infrastructure and the real estate sector (World Bank, 2019). Based on data from Feenstra et al. (2023) (Figure 2), the internal rate of return on investments has decreased from 11% in 2007 to a low of 7.5% in 2019. China's internal rate of return has been higher than that of the US every year from 2000 to 2019. This indicates that China earned a higher real return on investment than the US in that period. However, it is also noteworthy that China's internal rate of return has gradually declined since 2007, while that of the US has remained more stable. This could suggest that China's investments are experiencing diminishing returns, as mentioned before. One possible interpretation is that China's heavy investment in physical capital and infrastructure has boosted its economic growth but has also generated economic imbalances (Vázquez, 2022).

Figure 2. Internal Rate of Return.
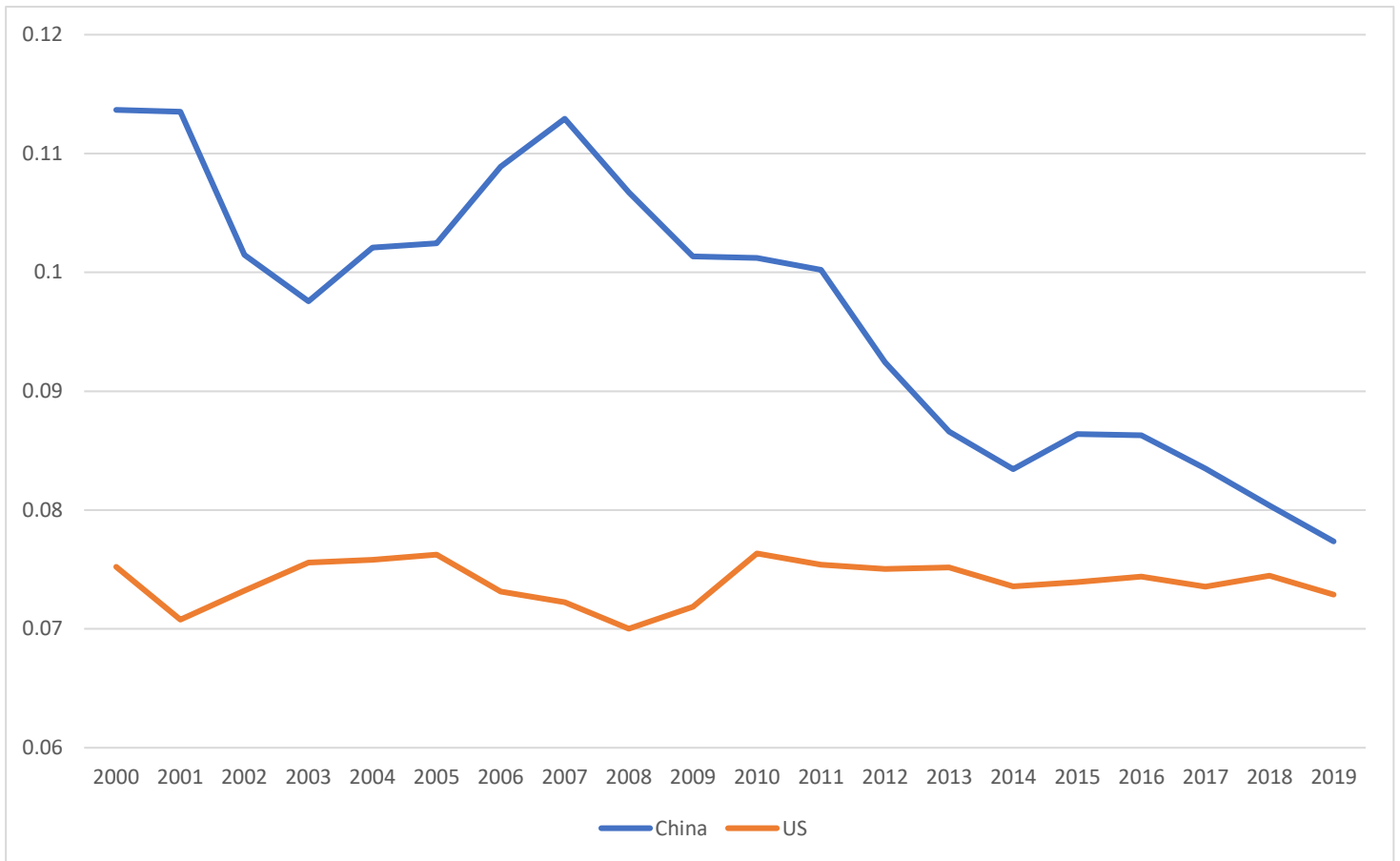
Source: Feenstra et al. (2023)

For its part, the contribution of the labor force has also declined sharply, as China's demographic dividends have reversed and the working-age population has begun to shrink (World Bank, 2019; García-Herrero, 2022). The growth rate of the working-age population (ages 15-64) began to decline in 2016, and the labor force is projected to shrink by 47 million, from 793 million in 2010 to 746 million in 2030 (World Bank, 2019). The sectoral reallocation of labor from agriculture to industry has been a driver of China's economic growth. However, the contribution of sectoral labor reallocation is likely to be more limited in the future (World Bank, 2019). Therefore, the progressive decline in rural-urban migration and the increase in labor demand driven by the growth of the service sector reduces the available labor force (Qi, 2018; Li, 2017; Vázquez & Orellana,

2021), increasing the bargaining power of workers and causing wages to increase above productivity (Barredo-Zuriarrain & Molero-Simarro, 2018). In addition, the reduction in rural-urban migration would also affect infrastructure investment (Vázquez, 2022).

In summary, this section has shown that China's growth model based on high investment, low consumption, and exports has faced some limits and challenges that have threatened its economic sustainability and efficiency. Declining returns to capital, shrinking labor force, and low consumption have reduced China's sources of growth and productivity. In addition, heavy reliance on investment has led to economic imbalances such as high levels of debt and excess capacity. These problems have led China to seek a new, more balanced, and inclusive growth model.

3.3.3. A change of model?

Chinese authorities have recognized the various challenges and imbalances of their economy, such as the imbalanced relationship between investment and consumption, uncontrolled expansion of certain industries (for example, steel, cement, or coal), excess capacity in some sectors, slow change in the economic growth mode, excessive energy and resource consumption (especially fossil fuels) and worsening environmental pollution (both air and water) (Vázquez, 2022). Recognizing these problems, they have expressed their commitment to transforming the country's economic model by focusing on balanced growth, innovation, and sustainability. This transformation aims to shift the drivers of economic growth toward a more balanced mix of consumption, investment, domestic demand, and external demand, moving from extensive growth to a more intensive growth model. Through the implementation of strategic policies and targeted reforms, the Chinese authorities plan to foster what they call high-quality development, reduce inequality, boost domestic consumption, increase technological self-sufficiency,

promote greener and more sustainable practices, and ultimately create a more resilient and balanced economy.

Before the 2008 crisis, Chinese authorities promoted the "Scientific Development" and "Harmonious Society" strategies to balance the national economic model, transform China into a technological powerhouse and improve wealth distribution (Molero-Simarro, 2014; Vázquez, 2022). During the 11th Five-Year Plan (2006-2010), they addressed issues such as the imbalance between investment and consumption, overcapacity, changing growth model, excessive consumption of fossil energy, and environmental pollution. To achieve a transition to a more balanced growth mode, China implemented various social improvements and supply-side structural reforms during the 12th Five-Year Plan (2011-2015). These measures were aimed at reducing excess capacity, lowering costs for enterprises and consumers, improving income distribution, and enhancing environmental protection. For example, China enacted a new labor contract law in 2008 to strengthen workers' rights and benefits, raised minimum wages in all provinces to boost household income and consumption, created a new social security system that covered more than 800 million people in 2015, raised agricultural commodity prices to increase farmers' incomes and narrow rural-urban income gaps, reformed rural health to expand basic health insurance coverage and improve the quality and accessibility of rural health services, and developed productive forces, structural adjustments and supply and total factor productivity through innovation-driven development strategies (Molero-Simarro, 2014).

Since the beginning of the 13th Five-Year Plan (2016-2020), China has deepened supply-side reform by focusing on five major tasks: cutting overcapacity, reducing inventory, deleveraging debt levels, lowering costs for businesses and consumers, and strengthening weak links in infrastructure and public services. Following this trajectory,

the 14th Five-Year Plan (2021-2025) and the long-term objectives for 2035 outline China's strategic priorities for the coming years (Central Committee of the Communist Party of China, 2020). The 14th Five-Year Plan sets key priorities such as increasing domestic demand and consumption as growth drivers; enhancing product and service quality and innovation; accelerating green and low-carbon transformation; strengthening technological self-sufficiency and national security; and promoting wider and more balanced global openness. The long-term objectives for 2035 envision China achieving socialist modernization, becoming a global leader in innovation, building a modernized economy, improving people's quality of life, advancing ecological civilization, enhancing national strength, and more.

In this vein, the 2020 Government Work Report examines the COVID-19 pandemic's impact on China's economy, proposing policies and objectives to address the crisis (Li, 2020). In a similar line, the 2021 Government Work Report reviews China's achievements and challenges in 2020 while presenting major measures and goals for 2021 (Li, 2021). These include expanding the domestic market and improving the distribution system; supporting innovative enterprises and emerging industries; promoting ecological modernization and emission reduction; reinforcing scientific and technological research capacity; and deepening economic system reform and openness (Li, 2021). Key proposals involve stimulating domestic consumption and facilitating the flow of goods and services; fostering the development of new infrastructure and digital industries; promoting coordinated regional and rural-urban development; increasing support for scientific and technological innovation; and upholding multilateralism and international cooperation. China also seeks to improve income distribution to reduce inequality and boost consumption (Li, 2020). The 2021 Government Work Report underlines the need to increase the incomes of low-income groups and expand the middle class; enhance social

security and welfare systems; and strengthen fiscal redistribution and market regulation (Li, 2021)

By addressing these challenges, China aims to create a more balanced and inclusive economy, fostering domestic consumption and overall growth. These measures aimed to stimulate private consumption by increasing wage shares in the national product, thereby reducing household saving rates and, consequently, decreasing inequality (Molero-Simarro, 2014; Vázquez, 2022). However, the implementation and outcomes of these measures have been uneven over the years.

When the 2008 crisis erupted, and global demand plummeted, the Chinese government recognized that relying heavily on exports to maintain growth was unsustainable. To boost domestic demand, it primarily focused on investment, which subsequently became a regular lever for stimulating growth. Specifically, authorities opted for large-scale public investment, approving a 4 trillion yuan fiscal plan between 2009 and 2010. This injection accounted for 12.5% of China's GDP; however, some studies estimate it could have reached 9 trillion yuan (28% of GDP) (Dong & Xia, 2020). From that moment on, export dependence began to decrease, leading to an increased reliance on investment (Vázquez, 2022).

The fiscal stimulus plan primarily focused on infrastructure projects, allocating 37% of the total budget to the construction of railways, roads, and airports (Gerig, 2019). At the same time, it aimed to address the underutilization of production capacity in certain heavy industry sectors, which exceeded 30% (Gerig, 2019). However, despite maintaining GDP growth, these measures were contradictory to the need for rebalancing the Chinese economy, as they encouraged traditional investment-driven growth mechanisms (Gerig, 2019; Vázquez, 2022).

With Xi Jinping's rise to power in 2012, the economic strategy has focused on

accelerating the privatization and liberalization of the productive and financial sectors, addressing regional inequality through the development of the country's western regions, improving social and environmental protection, and promoting domestic consumption and the service sector as drivers of Chinese economic growth (Wagner, 2019). Nevertheless, similarly to the 2008 crisis, the Chinese government has directed fiscal stimulus towards an infrastructure investment plan in response to the COVID-19 crisis. The fiscal stimulus package approved in the first half of 2020 amounts to 5 trillion yuan (approximately 5% of GDP) (Vázquez, 2022).

In the context of China's plans to rebalance its growth pattern, that is, to reduce dependence on exports and investment and increase domestic consumption while promoting technological autonomy and high value-added production, progress has been uneven. As shown in Figure 1, Although China's GDP reliance on trade has declined from its peak of 26.1% in 2010 to 20.6% in 2021, and consumption has increased from its low point of 48.9% in 2010 to 54.3% in 2021, the latter's growth has been modest. In comparative terms, high-income countries such as the US and the United Kingdom had consumption above 80% of their GDP in 2021. Middle-income countries such as Chile and Uruguay also outperformed China, with figures around 75%. Despite this modest share of consumption, gross capital formation in China has shown considerable strength. In 2021, investment accounted for 43% of GDP, far outpacing high-, middle- and low-income countries. In short, although consumption in China has increased modestly over the past two decades, the country's economy remains heavily oriented toward investment, a characteristic that distinguishes it from other economies, both developed and developing. (Vázquez, 2022).

In a similar vein, in 2022, investment emerged as the primary driver of growth (1.5%), surpassing both consumption (1%) and exports (0.5%). This reverses the pre-

pandemic trend (2010-2019), during which consumption experienced more significant growth and progressively contributed more to GDP. Additionally, inequality reportedly increased in 2022, posing an obstacle to consumption (NBSC, 2023).

The slight increase in consumption as a share of GDP has been supported by a growing share of labor income, reversing a two-decade negative trend, as well as by a declining savings rate (World Bank, 2019). Along these lines, per capita spending by Chinese households increased from $1,340 in 2007 to $4,062 in 2019, and per capita income rose from $6,810 to $19,503 over the same period.

In terms of sectors of activity, according to NBSC data, in 2007, the Chinese economy had a primary sector accounting for 10.2% of GDP, a secondary sector for 46.9% of GDP, and a tertiary sector for 42.9% of GDP. By 2019, the tertiary sector became the most relevant sector in the Chinese economy, comprising 53.9% of GDP, while the secondary sector accounted for 39% and the primary sector for 7.1% (NBSC, 2023). However, in 2020 and 2022, a reversal of this trend was observed due to the impact of the COVID-19 pandemic and the containment measures adopted by the Chinese government. Thus, the tertiary sector reduced its share of GDP to 54.5% in 2020 and 52.8% in 2022, while the secondary sector increased its share to 37.8% in 2020 and 39.9% in 2022, and the primary sector remained at around 7% (NBSC, 2023).

Duckett (2020) notes that between 2007 and 2018, government spending on education grew practically not at all, from 14.4% to 14.6% of GDP. As for social security and employment support, it increased from 10.9% to 12.2%, while in healthcare, it grew from 4% to 7.1% in the same period. However, according to data from NBSC (2023), 2020 saw a significant increase in government social spending in these three areas due to the impact of the COVID-19 pandemic and the containment measures adopted by the Chinese government. Thus, public spending on education stood at 3.76 trillion yuan, an

increase of 3.5% over the previous year. Meanwhile, public spending on social security and employment amounted to 3.39 trillion yuan, an increase of 9.2%. Finally, public spending on healthcare reached 2.45 trillion yuan, an increase of 11%.

On the other hand, China's production model has undergone a remarkable development at the technological level, consolidating significantly within global value chains and acquiring greater autonomy (García-Herrero et al., 2019; Woetzel et al., 2019; Malkin, 2020). Since the global financial crisis, the country has reduced its dependence on foreign inputs in its exports, simultaneously strengthening the vertical integration of its supply chain and providing intermediate goods to other countries for their export production (García-Herrero et al., 2019; Woetzel et al., 2019). In this vein, Figure 3 presents the foreign/domestic value-added ratio data over several years. This ratio represents the proportion of foreign value added to domestic value added in the country's exports. The data show a downward trend in the ratio, despite a rebound in 2018 to 0.20, indicating that China has managed to reduce its dependence on foreign inputs and increase its domestic value-added content in exports from the highs of 0.31 in 2004. This suggests that the country has been working on boosting its domestic industry and achieving greater technological autonomy. The chart highlights China's progress toward greater domestic productive capacity and its integration into GVCs.

Figure 3. Ratio Foreign/Domestic Content Ratio in China's Exports
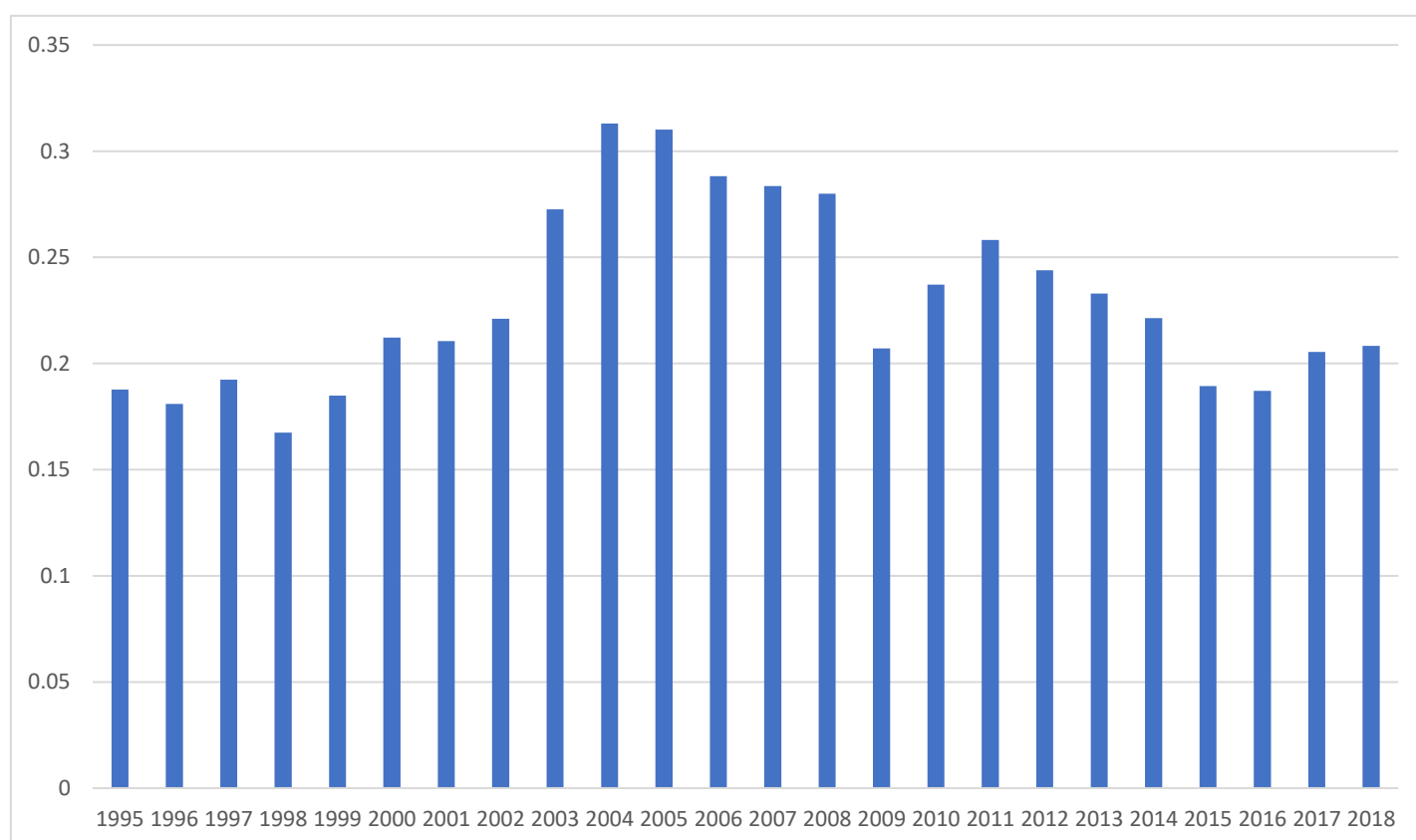
This transformation has resulted in significant progress in its upward trajectory in the global value chain. China is producing increasing domestic value added that is used in export production and is therefore decreasing its share in the global value chain (GVC), implying less dependence on foreign inputs. These changes suggest that China is undergoing rapid vertical integration and achieving greater technological and commercial autonomy (García-Herrero et al., 2019; Woetzel et al., 2019).

The technology sector is a clear reflection of the transformation of China's production model, having established itself as a global player in the digital economy and artificial intelligence technologies, 5G, battery electric vehicles, and clean energy technologies (Woetzel et al., 2019). The increasing localization of value chains in various sectors is another indicator of China's growing autonomy. For example, in sectors such

as solar panels, high-speed trains, digital payment systems, and electric vehicles, Chinese players account for more than 90% of the domestic market (Woetzel et al., 2019).

In this context, China has become less exposed to the rest of the world, while the world has become more exposed to China in terms of trade, technology, and capital (Woetzel et al., 2019). The decrease in China's exposure is partially reflected in the reorientation of its economy towards domestic consumption. In addition, the increase in the rest of the world's exposure to China reflects the growing importance of China as a market, supplier, and source of capital (Woetzel et al., 2019).

In summary, the results of the change in the Chinese model have been mixed. On the one hand, despite the previous trend of a gradual increase in the share of consumption in GDP until 2019, in the post-pandemic period, this trend has been reversed and continues to maintain very low levels compared to other countries. For its part, investment continues to have a significantly high weight in GDP, and although trade has a lower weight, the trend has also changed between 2020 and 2022. On the other hand, China has managed to develop its production model, climbing the global value chains and gaining technological autonomy, which has led it to compete in the development of cutting-edge technologies.

3.3.4. The property bubble in China

The Chinese growth model presents significant imbalances, particularly in the real estate sector, due to its substantial structural impact on the country's economy. The sector was responsible, either directly or indirectly, for a quarter of China's GDP in 2021, outpacing all other countries worldwide (Rogoff & Yang, 2021). The driving force behind this event was a combination of a strategy centered on investment growth and accelerated urban evolution. An increase in earnings and easy credit availability led to a surge in real estate

demand. On the other hand, limitations on land availability and a dearth of alternative investment opportunities contributed to a price surge. The funding for both regional and national governments has also been greatly dependent on property development and sales (Rogoff & Yang, 2021).

China's real estate sector has, for a considerable time, concealed its weaknesses, thanks to plentiful financial liquidity and sustained economic expansion. Nevertheless, these deficiencies became evident when the Chinese regulatory authorities addressed the consistent escalation of house prices, leading to affordability and income distribution issues. To restrict developers' reliance on debt, a regulatory body launched the "three red lines" policy in the summer of 2020, which proved to be a precarious move that certain entities, including Evergrande – the largest property developer in China and globally in terms of assets – found unmanageable (García-Herrero, 2022).

Beginning in 2021, the possibility of a real estate market crash has been growing apparent, provoking a downturn in the industry. This was evidenced by a series of setbacks, including a 10% reduction in real estate investments, a 39.4% slump in housing construction initiation, a 15% cutback in completed housing, a 53.4% fall in land acquisitions, and a 25.9% shrinkage in funding sources for the sector (NBSC, 2023). In the summer of 2021, Evergrande's failure to repay foreign debt initiated a cascading effect, causing multiple developers to default, thereby collapsing the real estate market. The fallout from this was a rapid drop in property prices and negative growth in double digits (García-Herrero, 2022).

The public's trust in the process of buying homes prior to their completion has been shaken, and the anxiety over the failure to receive a paid-for home ignited protest throughout 2022 (García-Herrero, 2022). The reduction in demand and housing prices adversely affects the market value of developers' assets, endangering their solvency and

liquidity. Financial institutions that provided funds for these purchases via home loans are also in jeopardy. In the current circumstances, declining sales have impacted the completion of various stalled projects, particularly those belonging to struggling developers. This has led to a heightened risk of non-completion, which subsequently depreciates developers' asset market value and weakens their solvency and liquidity (García-Herrero, 2022).

Moreover, in the initial half of 2022, mortgage defaults occurred as households had committed their savings to hefty down payments on projects that financially strained developers were unable to complete. Despite mortgage defaults being relatively low at this point, they present a significant threat to financial stability that China should keep an eye on in the future.

Considering this situation, it is imperative for the government to step in, giving priority to the completion of ongoing projects to avert social upheaval and boosting financing to stave off bankruptcies. The decline in buyers' trust in the presale model also puts a damper on policies aimed at stimulating housing demand. The gross cost of completing the stalled projects of troubled developers, without any additional funding or recovery through restructuring, is projected to be about 5% of GDP (IMF, 2023).

3.4. From the world factory to technological superpower

As highlighted earlier, the Chinese government is actively pursuing a transformation of its economic model to establish itself as a technological giant. This transformation entails a shift from a model propelled by investment and low-value-added manufacturing exports to one anchored in domestic consumption and the creation of high-value-added goods (Vázquez, 2022). Given China's economic clout and the global movement toward the

Fourth Industrial Revolution, this advancement could notably reshape the balance of global economic power (Thompson, 2020; Rikap & Lundvall, 2021).

In 2021, China introduced a strategy known as dual circulation, representing a new approach to development emphasizing domestic circulation, namely the amplification of internal consumption and technological innovation as catalysts for socio-economic development. Concurrently, China remains engaged in international circulation, involving trade and investment with other nations, but with a renewed focus on discernment and quality. By doing so, China aims to adapt to shifts in the internal and external landscape, such as the aging population, potential economic deceleration, escalating protectionism, and geopolitical rivalry. The overarching aim is to construct a modern socialist nation that is more affluent, equitable, and sustainable (Vázquez, 2022).

A significant move by President Xi Jinping's administration to promote high-value-added sectors and technological self-sufficiency is the MIC2025 initiative. This strategy aims to establish China as a premier producer of high-tech goods and decrease reliance on foreign components and materials by producing 70% of these domestically by 2025 (Vázquez, 2022). This initiative has ignited geopolitical friction with the US, as the competition in high-value-added goods manufacturing poses a threat to US dominance (Cuenca & Vázquez, 2021; Vázquez, 2022). Additionally, the 14th Five-Year Plan, ratified in 2021, defines economic objectives through 2025, underscoring the crucial role of technological progression in elevating the quality and efficiency of the Chinese economy. This plan also seeks to fortify national defense and security, broaden China's global influence as an emergent power, enhance environmental conservation, foster long-term sustainability, and stimulate development via dual circulation in both domestic and international trade.

Nonetheless, the technological rivalry between the US and China has escalated in

recent years, triggered by China's ambition to alter its production model and emerge as a technological leader. The US views this ambition as a menace to its dominance and national security, instigating a technological dispute to restrict China's rise. This contention is visible in the US's technology embargo against China, notably in the semiconductor industry, but also in other fields like 5G, artificial intelligence, and quantum computing. To counter this situation, the Biden administration has devised a state strategy aimed at restraining China and extending US dominance, with a central focus on the technological domain. National Security Advisor Jake Sullivan has delineated this strategy in several official documents, merging economic and foreign policies while identifying objectives and measures to compete with China in vital future areas. Sullivan (2023) asserts that the US must outpace China by several generations in critical technologies such as artificial intelligence, biotechnology, clean energy, cybersecurity, and space. To accomplish this, Sullivan (2022) proposes a strategy encompassing the enhancement of American science and technology, nurturing exceptional STEM talents, safeguarding American technological advantages, and reinforcing and integrating their alliances and partnerships.

Owing to the importance of these plans for both national and international technological development and the battle for supremacy with the US, this chapter will concentrate on several key areas within government strategies.

3.4.1. Standards

Standards are essential in contemporary technological development, as they facilitate global interoperability and establish a foundation for industries worldwide. By setting new standards for disruptive technologies, countries can define the sector's rules, capture licensing fees and royalties, and reinvest profits in research and development (Seaman,

2020). Leadership in this area allows major powers to outperform rivals economically, politically, and in terms of cybersecurity (Lewis, 2018).

In 2018, Chinese authorities introduced a new law that strengthened the development of standards driven by the private sector, although ultimately maintaining a dual (public/private) model with clear state predominance (Rühlig, 2020). Technical standardization serves as a means for industrial policy formulation and follows general frameworks like MIC2025 (Rühlig, 2020). As China's economy ascends the global value chain, product quality and innovation have become a priority for the People's Republic of China (Rühlig, 2020). Consequently, China's growing influence in international technical standardization could prompt third-party countries to consider the Chinese approach as a model to follow (Rühlig, 2020).

Complementing previous efforts, the government launched 2021 the more ambitious "Standards 2035" plan, developed in 2018 as an extension of MIC2025 (Rühlig, 2020). The plan aims to establish a national standardization development scheme focusing on enhancing the quality of Chinese standards and increasing their international presence. This strategy supports high-quality economic and social development and the construction of a modern socialist state.

By 2025, the plan envisions a transition toward market-oriented standards and increased application in the economy and society. It also aims to boost international cooperation in standardization and achieve greater coherence with international standards. By 2035, the plan expects a robust standardization system compatible with international standards and a Chinese-characteristic management system. Research in key technological areas, such as artificial intelligence, quantum information, and biotechnology, will be promoted. Technical standards will be developed in emerging sectors, including intelligent vehicles and robotics.

The key to this project is to set the primary global standards in disruptive technologies such as blockchain, the Internet of Things, new forms of cloud computing, Big Data, 5G, next-generation artificial intelligence, smart cities, and geographic information systems (Rühlig, 2020). While MIC2025 focuses on climbing global value chains, "Standards 2035" goes a step further, aiming to set the rules for 21st-century capitalism technologies. Although China's standard reform is geared toward national industry modernization, it has a clear geostrategic focus to increase its presence in existing international standardization organizations. Thus, enhancing technical standards creation has become a central piece of industrial policy to improve the quality of Chinese products (Rühlig, 2020).

Under the BRI, projects agreed upon with third-party countries function as packages, including financing, design, and construction of infrastructure based on Chinese technical standards (Rühlig, 2020). By accepting these packages, countries will depend on Chinese manufacturers for decades for maintenance and the construction of compatible infrastructure (Rühlig, 2020). Additionally, as a complement to the BRI, Beijing announced the DSR in 2015 as a key strategy for internationalizing its technological model (Triolo et al., 2020).

DSR investments aim to enhance recipients' telecommunications networks, AI capabilities, cloud computing, e-commerce, mobile payment systems, surveillance technology, smart cities, and other high-tech areas. Moreover, the DSR also provides support for Chinese exporters, such as Huawei (Triolo et al., 2020). By combining these efforts with strategies such as MIC2025 and "Standards 2035", China is working toward shaping the rules of future technologies and expanding its presence in international standard-setting organizations. This way, the promotion of technical standards has become a central piece of industrial policy to improve the quality of Chinese products

(Rühlig, 2020).

3.4.2. Artificial intelligence

AI is a critical component of the Fourth Industrial Revolution, with leading countries and companies poised to reap significant advantages (Rikap & Lundovall, 2021). Recognizing AI's transformative potential, China has set an ambitious goal to become the world leader in AI by 2030. The Chinese government actively invests in AI research and development, fostering innovation ecosystems and promoting collaboration between research institutions, universities, and private enterprises (Rikap & Lundvall, 2021).

China's commitment to AI is evident in its policy initiatives and achievements across various industries, such as education, healthcare, security, and defense. The country has introduced the New Generation Artificial Intelligence Development Plan and the 14th Five-Year Plan (2021-2025), which outline various measures to promote AI innovation and development (Rikap & Lundvall, 2021).

China has made significant progress in AI's technical domains, including facial recognition, natural language processing, and autonomous vehicles (Ding, 2018). Despite these ambitious plans and achievements, China faces some limitations in AI development (Ding, 2018). For instance, the country lags behind the US in critical areas of AI, except for data access. China's weaknesses include semiconductor access, hardware, and access to talent, with the most significant challenge being semiconductors needed for AI development (Ding, 2018). To overcome these obstacles, Beijing supports its national champions with substantial funding and encourages domestic companies to acquire chip technology through overseas deals (Ding, 2018). The potential benefits of AI for China could be significant, with 51% of labor activities potentially automatable (Barton et al., 2017; Ding, 2018). However, excessive speculative investment may lead to abrupt boom

and bust cycles (Ding, 2018). Moreover, China's top-down approach to scientific innovation has been criticized for diverting resources away from bottom-up, researcher-driven projects towards large, low-quality national projects due to personal connections (Ding, 2018).

According to Barton et al. (2017), China has built a strong foundation to support an AI-based economy, making significant global contributions in the field over the last decade. The country has a unique opportunity to leverage AI applications in sectors such as healthcare, retail, and education, potentially increasing its GDP by up to $600 billion by 2030. To capitalize on this economic potential and address the international implications of China's AI ambitions, the country must address key challenges, such as optimizing data quality and availability, enhancing talent and innovation capabilities, and establishing a conducive regulatory and ethical environment for AI. Addressing these challenges can drive trust and adoption of AI technologies both nationally and internationally, as well as shape the global landscape of AI development and governance.

3.4.3. 5G

China's aspiration to become a technological superpower is strongly connected to its focus on 5G technology as a key enabler of the Fourth Industrial Revolution. The Chinese government supports the rapid deployment of 5G infrastructure, encourages innovation in 5G applications, and fosters international cooperation to promote the adoption of Chinese 5G technology worldwide. By leading in 5G, China aims to boost its industries, facilitate the digital transformation of its economy, and enhance its position as a global leader in the field of wireless connectivity (Cuenca y Vázquez, 2021).

The latest Chinese Five-Year Plan (2021-2025) (Government of the People's Republic of China, 2021), issued by the Central Committee of the Communist Party, sets

specific goals in this area. In particular, advancements in 5G and 6G technologies are considered crucial for driving industrial transformation and high-quality growth. As part of this effort, China plans to establish over 10,000 5G-enabled factories during the five-year plan period to foster the application of 5G technology in the industrial internet. This concept refers to the use of information and communication technologies to interconnect machines, data, and people in the industrial sector, thereby improving the efficiency, quality, and safety of production processes. To achieve this, China will accelerate the construction of 5G networks and expand their application in various fields, especially in manufacturing. Additionally, research and development of emerging communication technologies, such as 6G, will be promoted.

The Chinese telecommunications company Huawei is a key player in the strategy of the CCP to gain influence abroad, following the techno-nationalist tactic of "Going Out" (zou-chu-qu) (Kim et al., 2020). Moreover, Huawei has become a symbol of the technological rivalry between China and the US, especially in the field of 5G technology, where both countries compete to lead the global market. However, Huawei faces opposition from the US and other countries that question its alleged ties to the CCP and the possible security risks that its 5G infrastructure entails. Therefore, the US and some of its allies have taken measures to restrict Huawei's operations, which has increased tensions between China and the US in the race for 5G dominance. (Sun, 2019).

The development of global standards for 5G within the 3GPP framework is a key aspect of the broader technological competition between China and the US. As both countries vie for a leading position in the global 5G market, the ability to generate cutting-edge innovation and influence the technical specifications of this technology has become crucial. China has been investing heavily in its 5G infrastructure and expanding its presence through strategic initiatives and international partnerships, while the Us has been

trying to counter China's influence and protect its own interests. The number of Chinese companies with voting rights in the 3GPP has more than doubled in recent years, reaching 110 in January 2020, compared to 53 US members with voting rights (USCBC, 2020). This indicates that China is gaining an edge over the Us in the race for 5G dominance, which is likely to remain a defining feature of the evolving 5G landscape. (Seaman, 2020).

3.4.4. Semiconductors

Semiconductors are a critical component of modern electronics, and China is dedicated to achieving self-reliance in this essential industry. The government supports the development of advanced semiconductor technologies, nurtures domestic talent, and promotes the growth of a competitive semiconductor ecosystem. By increasing its capabilities in semiconductor manufacturing and design, China seeks to reduce its dependence on foreign suppliers and enhance its position in the global electronics market (Made in China 2025).

The strategic plan MIC2025 (launched in 2015) aims to transform China into a global leader in innovation and advanced manufacturing, targeting the semiconductor industry as one of the key sectors for self-sufficiency and reducing dependence on foreign chip suppliers. The National Integrated Circuit Industry Development Guidelines (introduced in 2014) outline the government's strategy for developing the integrated circuit industry, including policies, funding, and support for research and development, talent cultivation, and market expansion. The China Integrated Circuit Industry Investment Fund, also known as the "Big Fund," established in 2014, plays a crucial role in supporting key semiconductor projects and companies in China.

The 14th Five-Year Plan (2021-2025) emphasizes the importance of self-reliance in key technologies, including semiconductors, and calls for increased investment in

research and development, advanced manufacturing, and the establishment of a complete semiconductor supply chain. In addition to these national plans, various provincial and municipal governments have introduced their own initiatives and incentives to support the semiconductor industry's growth. Cities like Beijing, Shanghai, and Shenzhen have established semiconductor industry development funds and offered tax breaks and other incentives to attract investment in the sector.

Furthermore, the Chinese government encourages domestic semiconductor companies to form partnerships with international firms to access advanced technologies, expertise, and intellectual property, accelerating the development of China's domestic chip industry. However, the US administration's unprecedented offensive against the Chinese chip industry in 2022 aimed to curb China's access to necessary technology and supplies for manufacturing and designing advanced chips.

Among the measures implemented by the Biden administration, the scope of the "Foreign Direct Product Rule" was expanded. This rule allows the US government to control chip exports manufactured globally using US tools, targeting sanctioned Chinese entities for national security or human rights reasons. The rule was previously applied to Huawei and SMIC (China's largest chip manufacturer) and was extended to other Chinese companies like YMTC, China's leading memory chip producer.

Another measure taken by the administration involved implementing export licenses for shipping chip manufacturing equipment and materials to China and providing technical services or assistance to Chinese companies in the sector. These licenses would only be granted in exceptional cases and under strict conditions.

Additionally, the US Department of Commerce (Bureau of Industry and Security, 2022) blacklisted 30 Chinese entities related to the chip industry, requiring prior authorization for conducting business with them. Among these entities were leading

Chinese companies involved in chip design or production for artificial intelligence, such as Cambricon or CETC. These measures dealt a severe blow to China's chip industry, which heavily relies on US technology and foreign suppliers using US technology. According to some analysts, these measures could delay the development of the Chinese industry by several years and affect its competitiveness and innovative capacity. They could also have negative effects on China's economic stability and growth, as well as global supply chains and financial markets.

However, China's ambition to develop its semiconductor industry has faced strong opposition from the US, which views China's advancement as a threat to its national security and competitiveness. In this context, the Biden administration launched an unprecedented offensive against the Chinese chip industry in late 2022 through a series of restrictive measures aimed at curbing its access to the technology and supplies needed to manufacture and design advanced chips. These measures are part of the broader containment strategy towards China, aimed at curbing its rise as a technological power. National Security Advisor Jake Sullivan has expressed the need for the US to be several generations ahead of China in critical technologies (Sullivan, 2022) and proposed a strategy that includes investing in our science and technology, nurturing the best STEM talents, protecting our technological advantages, and deepening and integrating our alliances and partnerships (Sullivan, 2022).

The implemented measures by the Biden administration against the Chinese chip industry reflect the US's efforts to maintain its competitive edge and prevent China from gaining ground in the semiconductor sector (Bureau of Industry and Security, 2022). These containment measures, as part of the broader US national security strategy, could have profound implications for the future of the international order as they seek to halt China's technological and military rise.

3.4.5. Energy transition

China is vigorously investing in renewable energy resources, including solar, wind, and hydroelectric power, to meet its energy demands and shrink its carbon emissions (Zhao et al., 2022; Jiang & Liu, 2022). The government is dedicated to increasing the proportion of non-fossil fuels in its energy configuration, fostering energy conservation, and pushing forward with clean energy technology. By creating a green and low-carbon energy system, China aspires to reach its environmental targets and contribute to worldwide ecological sustainability (Zhao et al., 2022; Jiang & Liu, 2022).

Since 1978, China's economic expansion has been largely fueled by coal, leading to severe environmental consequences, including air, water, and soil pollution. As the primary global emitter of greenhouse gases, China accounts for more than 25% of worldwide CO_2 emissions control (Holzmann & Grunberg, 2021). Environmental pollution has become a critical public health issue, costing hundreds of billions of Chinese yuan each year. In response to this unsustainable situation, the Chinese government has made ecological development and climate action a priority, with particular attention to pollution control (Holzmann & Grunberg, 2021).

Moreover, strained relationships with key raw material suppliers on a global scale have encouraged China to pursue increased autonomy and security in this sector. China is a net importer of crucial resources such as grain, soy, oil, and gas, exposing it to potential external disruptions (Zhao et al., 2022; Jiang & Liu, 2022). An environmentally sustainable approach in agriculture and industry promotes efficiency and self-reliance in national supply chains, primarily by reducing dependence on critical resource imports. Environmental health also has growing public concern due to severe pollution leading to one million premature deaths and costing hundreds of billions of yuan annually (Zhao et

al., 2022; Jiang & Liu, 2022).

Several research endeavors have been instrumental in promoting China's renewable energy development. Jiang and Liu (2022) explore the influence of innovation policies on wind energy in China, unveiling significant yet complex impacts on both exploitative and exploratory innovations. Li et al. (2023) scrutinize the advancements and challenges in China's energy production revolution during 2015-2019, emphasizing hurdles such as inadequate technological innovation and limited clean energy consumption and storage capacity. Zhao et al. (2022) present a current overview of renewable energy in China, discussing the challenges of its development within the framework of carbon neutrality goals and proposing survival strategies. Li et al. (2023) assess the growth of wind energy in China and the policies backing it over the past 20 years, suggesting that future policies should bolster market allocation, optimize the business environment, and improve resource utilization efficiency.

The quest for sustainable economic progress presents a remarkable opportunity to assume technological leadership. Initiatives such as MIC2025 advocate for advancements in domestic innovation, particularly in the realm of green technologies (Holzmann & Grunberg, 2021). In light of this, Beijing has commenced a systematic push in science, technology, industry, policies, and everyday life. While environmental policies are advancing, they do so at varied paces. Many of these policies are specific and lack a systematic approach, occasionally conflicting with growth and social stability-oriented policies. Government officials may hesitate to promote ecological initiatives due to potential adverse socioeconomic repercussions (Holzmann & Grunberg, 2021).

Beijing's strategic commitment to a sustainable future hinge on achieving state-guided and financed technological breakthroughs that enable an ecological transformation in the country and worldwide technological leadership in various areas,

145

ranging from renewable energies to environmental protection equipment. China's state-supported R&D endeavors are starting to yield results in green technological innovation; however, a substantial number of green technology patents (e.g., in wind energy) do not necessarily equate to high-quality outcomes (Holzmann & Grunberg, 2021).

Furthermore, China's ecological transformation is propelled by developments in energy-related technologies (e.g., energy conservation and alternative energies), and transportation and smart grid technologies, particularly those focusing on charging infrastructures for electric vehicles. Beijing highly values green technologies, a term that, in the Chinese political context, encompasses virtually any technology, material, or equipment that aids climate action and promotes a circular and sustainable economy. Strategic plans such as the "13th Five-Year Plan for Emerging Strategic Industries" and the MIC2025 initiative encourage progress in these green technologies (Holzmann & Grunberg, 2021).

In summary, China's pursuit of renewable energy and sustainable development is influenced by its need to address environmental concerns, reduce its dependence on fossil fuels, and achieve its climate goals. While significant progress has been made in renewable energy development, various challenges remain, such as promoting renewable energy consumption, improving energy storage technology, and integrating the grid. By overcoming these challenges and continuing to invest in green technologies, China can transition to a more sustainable, low-carbon future while maintaining its economic growth and global influence.

3.5. China in the international arena

Since the second term of Hu Jintao and particularly with the advent of Xi Jinping, China

has accelerated its strategy for technological development and independence, taking on a more proactive role in the international arena. Its most ambitious plan is the BRI announced by Chinese President Xi Jinping in 2013 (Mendez et al., 2022). The BRI aims to promote regional integration, boost trade, and stimulate economic growth by connecting China with Asia and Europe through a transportation network. As part of the BRI, Beijing announced 2015 the DSR, a major strategy for internationalizing China's technological model (Triolo et al., 2020). DSR investments aim to improve the telecommunication networks of recipient countries, AI capabilities, cloud computing, e-commerce, mobile payment systems, surveillance technology, smart cities, and other high-tech areas while also providing support for Chinese exporters, such as Huawei (Triolo et al., 2020).

The DSR addresses the needs of countries in Africa, the Middle East, parts of Eastern Europe, Latin America, and Southeast Asia for affordable, quality technology to expand digital communication networks (Cuenca & Vázquez, 2021). Chinese companies promote training centers and research and development cooperation between scientists and engineers from recipient countries and their Chinese counterparts within the DSR framework (Sierra, 2021). This approach is crucial for transferring technical knowledge in areas such as smart cities, artificial intelligence, robotics, and renewable energy (Sierra, 2021). In Africa, for example, China already provides more funding for information and communication technologies than all multilateral organizations and major democracies combined on the continent (Kurlantzick, 2020).

The BRI and DSR together allow China to strengthen its international economic relations, alleviate internal imbalances, and significantly enhance its soft power capacity (Smith, 2018; Morrison, 2019). Internally, they seek to resolve excess capacity in China's infrastructure, manufacturing sectors, and technology industries, promote economic

growth in less developed regions (Mendez et al., 2022), and export surplus capacity to the rest of the world, thereby transferring the contradictions and limitations of the Chinese economic model described in section 3 (Kenderdine & Ling, 2017). Externally, the BRI and DSR aim to expand China's influence and soft power while securing access to resources and markets (Mendez et al., 2022).

By promoting infrastructure construction and connectivity between countries, the BRI helps alleviate China's overcapacity problem in traditional industries, such as iron, steel, and cement (Fangye, 2022). As countries along the Belt and Road routes engage in infrastructure projects, the demand for these building materials increases, allowing China to export more of its excess production capacity. Cooperation in energy infrastructure development within the BRI, including oil and gas pipelines, electricity networks, and renewable energy projects, enables China to secure more stable and diversified energy sources while sharing its expertise in energy development with partner countries (Fangye, 2022).

The initiative creates new markets for Chinese products by improving trade facilitation and connectivity. Encouraging infrastructure development and cross-border cooperation opens up opportunities for Chinese companies to export a wide range of goods, from complete sets of equipment for high-speed railways, ports, and communications to high-end manufacturing products. This expansion of overseas markets is crucial for the transformation and upgrading of China's manufacturing industry (Fangye, 2022).

Furthermore, the BRI and DSR promote innovation and development in the service and technology industries, providing financial convenience and humanistic advantages for China's service industry to "go global" and effectively improving its innovation capability and international competitiveness (Fangye,2022; Triolo et al.,

2020). The DSR investments aim to improve the telecommunication networks of recipient countries, AI capabilities, cloud computing, e-commerce, mobile payment systems, surveillance technology, smart cities, and other high-tech areas, making them more connected and digitalized (Cuenca & Vázquez, 2021).

The BRI and the DSR are strategic efforts that serve to bolster the technological infrastructure of beneficiary nations. These programs are instrumental in redressing imbalances and tackling economic challenges within China. Simultaneously, they foster regional integration, enhance trade, and spur economic growth. The BRI allows China to export its excess production capacity by encouraging infrastructure development and cross-border cooperation, opening up opportunities for Chinese companies to export a wide range of goods and services, from complete sets of equipment for high-speed railways, ports, and communications to high-end manufacturing products (Fangye,2022). Meanwhile, the DSR provides Chinese exporters with support, such as Huawei, in expanding their digital services to other countries (Triolo et al., 2020).

In addition to promoting economic growth and technological development, the BRI and DSR are also part of China's foreign policy to strengthen economic ties with the countries along the Belt and Road, creating new markets for Chinese products and services, particularly in the construction, steel, and cement industries (Lai, 2020). They are crucial for expanding China's influence and soft power, securing access to resources and markets, and establishing stronger economic and political relationships with recipient countries, which may benefit China in the long term (Mendez et al., 2022; Vázquez, 2022).

However, the BRI and DSR have also faced criticisms and concerns, particularly regarding their potential to create debt traps for recipient countries, environmental impacts, and national security risks (Rühlig, 2020; Sierra, 2021; Kurlantzick, 2020).

These issues require careful consideration and monitoring to ensure that the BRI and DSR are implemented in a sustainable, transparent, and mutually beneficial manner for all parties involved. Moreover, countries such as the US, Australia, Japan, and some European states have attempted to limit the expansion of Chinese tech giants and prevent Beijing from establishing norms for the Internet, 5G networks, and other areas. This has accelerated Beijing's efforts to internationalize its tech companies in developing markets, compensating for the exclusion from wealthier states (Triolo et al., 2020). Consequently, the expansion of Chinese companies in constructing digital infrastructure in these developing countries will require adaptation to Chinese standards (Triolo et al., 2020).

In addition to the BRI and DSR, China has launched other international projects to expand its economic and political influence worldwide. One of these projects is the AIIB, established in 2015. The AIIB is a multilateral development finance institution aiming to finance infrastructure projects and promote sustainable development in Asia and other regions. Headquartered in Beijing, the AIIB has more than 100 members, including Asian, European, African, and Latin American countries. China is the largest shareholder in the bank, followed by India, Russia, and Germany. The AIIB was created to address the growing demand for infrastructure investment in Asia and to complement the work of other existing development finance institutions, such as the World Bank and the Asian Development Bank (ADB). Simultaneously, the AIIB is a key component of China's strategy to increase its economic and political influence in the Asia-Pacific region and beyond. The AIIB finances projects in areas such as transportation, energy, telecommunications, urban and rural development, and the environment. China has also been instrumental in the creation of the New Development Bank (NDB), also known as the BRICS Development Bank, which was established by Brazil, Russia, India, China, and South Africa in 2014. The NDB aims to mobilize resources for infrastructure and

sustainable development projects in BRICS countries and other emerging economies. With its headquarters located in Shanghai, China plays a significant role in the NDB's functioning, reinforcing its efforts to extend global influence through multilateral initiatives.

Furthermore, China promotes regional initiatives, such as the Shanghai Cooperation Organisation (SCO), a political, economic, and security organization that includes China, Russia, India, Pakistan, and several Central Asian nations. The SCO aims to enhance cooperation in areas such as security, trade, investment, energy, and sustainable development among its member countries.

To summarize, China's ambitious initiatives, such as the BRI, DSR, AIIB, or NDB, serve both domestic and international objectives, allowing China to address its economic imbalances while also expanding its influence and securing access to resources and markets. The combination of infrastructure and digital investments creates long-term dependence on Chinese technology and services, enhancing China's position in the global landscape.

This trend is reflected in China's overseas investment (Figures 4 and 5), which steadily grew from $19.27 billion to $255.8 billion between 2005 and 2017, indicating China's increasing integration into the global economic system. However, China's investment declined from 2018 to 2020 due to various factors, including domestic economic slowdown, increased regulatory scrutiny, international competition, and the COVID-19 pandemic. Despite these challenges, China's continued investment in infrastructure and technology will likely shape the global economic and technological landscape for years to come.

Figure 4. China investment and construction by region. China Global Investment
Tracker data
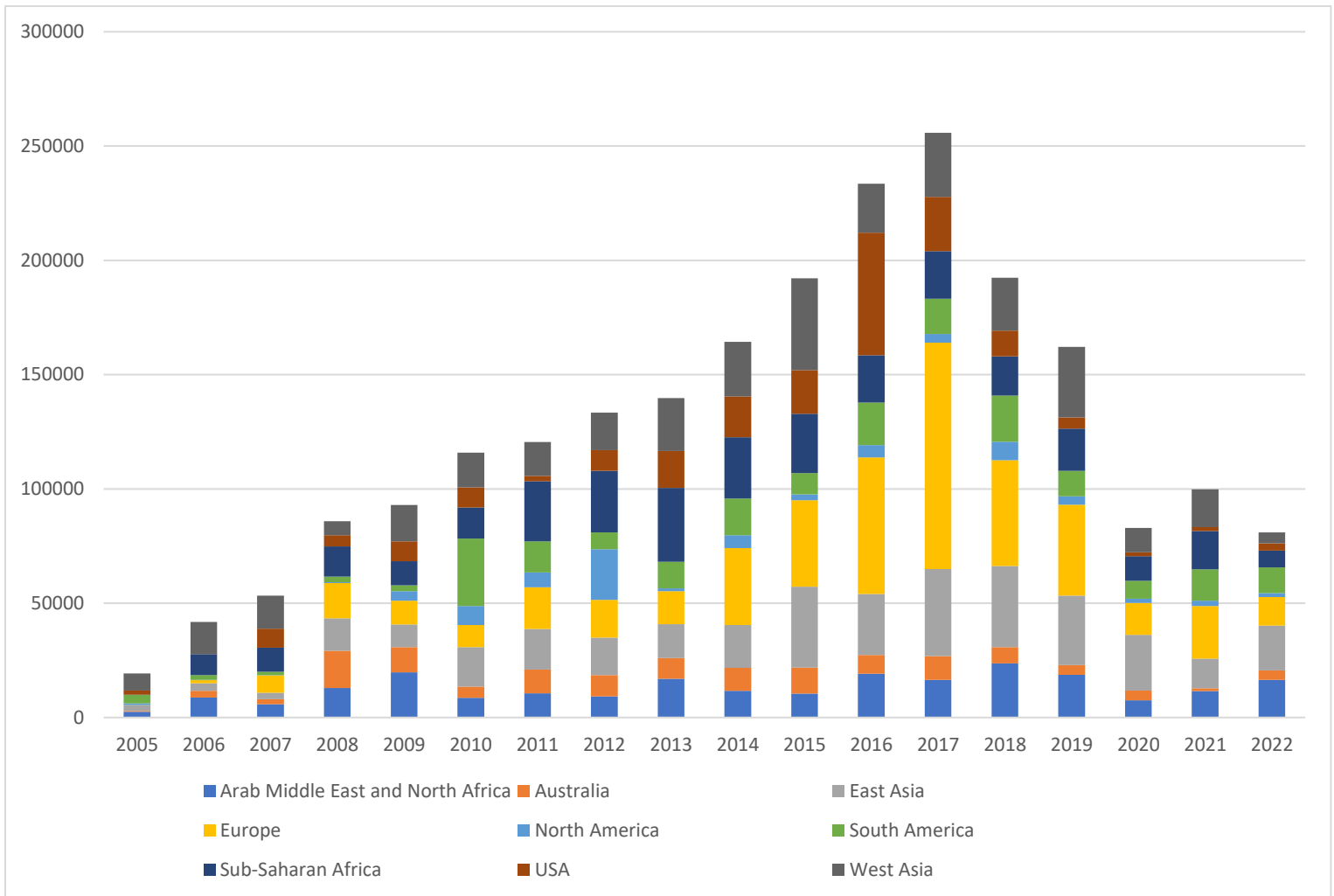
Source: American Enterprise Institute (2023)

Figure 5. Total Investment and construction by sector (2005-2022)
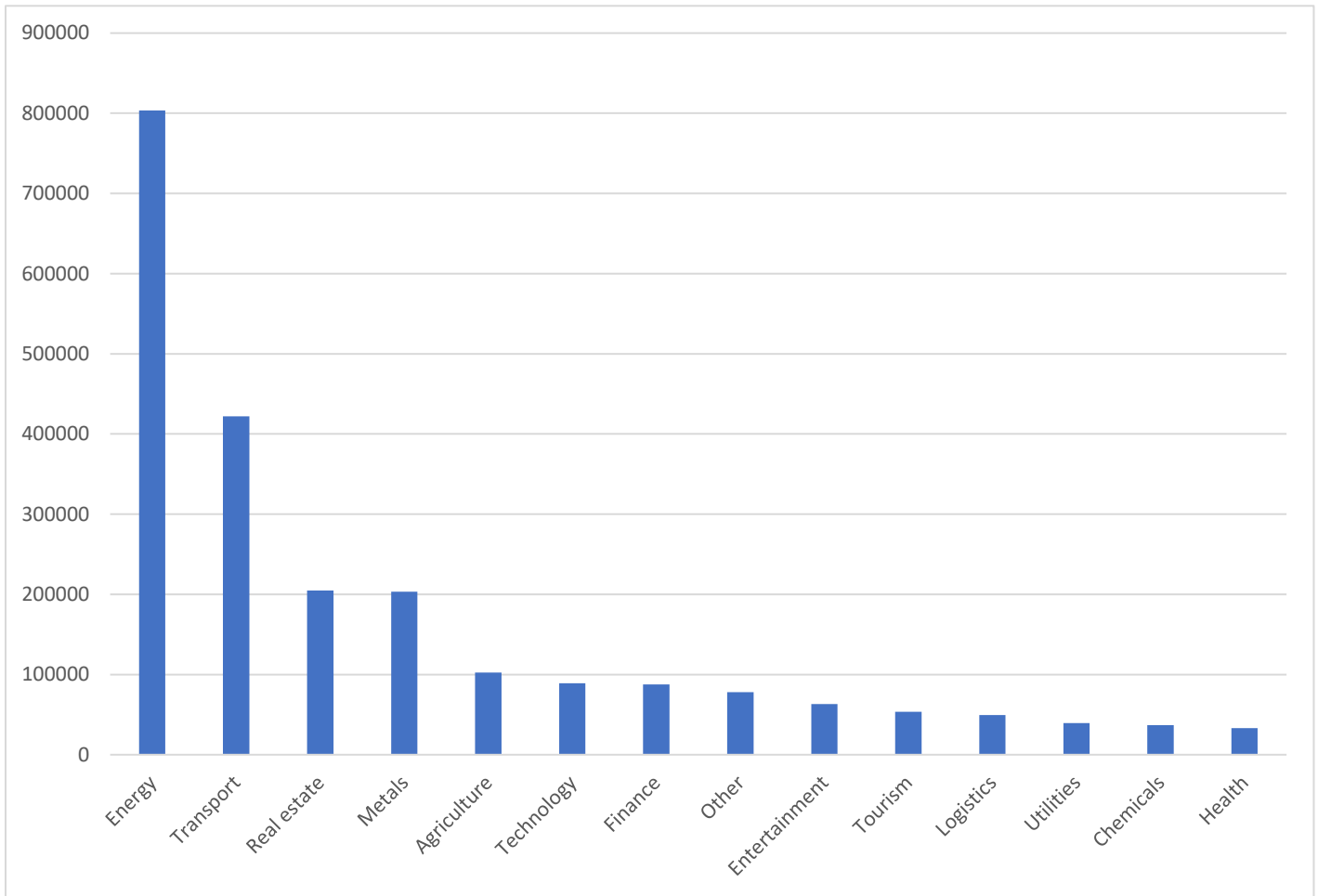
Source: American Enterprise Institute (2023)

In 2021, China's total overseas investment experienced a modest recovery, reaching $99.88 billion, likely due to post-pandemic economic revitalization and China's interest in maintaining its global presence and influence. However, in 2022, investment is expected to decrease to levels similar to 2020, around $80.93 billion, possibly due to the impact of China's zero-COVID policy. This policy may have disrupted economic activities and contributed to the decline in overseas investment. It will be interesting to observe the developments in 2023, following the end of the zero-COVID policy. A possible increase in overseas investment could be expected as China may seek to re-establish its international presence and resume the pursuit of its strategic goals.

Geographically, China's investments are focused on Europe, West Asia, and East

Asia, with other regions like the Middle East, North Africa, South America, Sub-Saharan Africa, and North America having strategic or prospective importance. Sector-wise, energy, transportation, real estate, and metals are the most significant (Figure 4).

On the other hand, between 2008 and 2021, the CODF database recorded 1,099 overseas development finance commitments by China, involving 100 countries and amounting to $498 billion. This positions Chinese Development Finance Institutions among the most active globally, with their loans representing 83% of the World Bank's sovereign loans during the same period. The distribution of these loans has been widespread, focusing particularly on Southeast Asia, Africa, and South America (Ray, 2020).

As the total value of Chinese overseas development financing has decreased, the average size of loan commitments has also diminished in terms of both monetary value and geographic scope. This trend signifies the "small is beautiful" approach adopted by China's economic engagement in recent years, which prioritizes smaller and more targeted projects (Ray, 2020).

Given the importance of the BRI, it stands as Chinese President Xi Jinping's flagship foreign policy project and the world's largest infrastructure program, aiming to connect China with Asia, Europe, and Africa through a network of transport, energy, and communications. The BRI represents China's strategic ambition to increase its economic and political influence in the regions where projects are developed and reinforce its position as a technological superpower. However, the BRI also poses a significant challenge to the interests of the US, which views China's expanding presence and power with suspicion.

The US has adopted a critical and competitive stance against the BRI, questioning its governance standards, transparency, environmental impacts, and human rights records

and offering an alternative vision for sustainable and inclusive development based on respect for international norms and multilateral cooperation (Meltzer, 2017; Hillman & Sacks, 2018). Consequently, the BRI has become a critical arena for the rivalry between the US and China for global leadership.

Considering the international projects mentioned earlier, such as the AIIB, NDB, and SCO, the BRI is part of China's broader commitment to expanding its influence and presence globally. Through these initiatives, China establishes stronger economic and political relationships with countries in various regions, increasing its capacity to influence decision-making and shape international norms and standards. Ultimately, these projects position China as a key player in the international economic and political landscape, reinforcing its role in shaping the global order while simultaneously intensifying the rivalry with the US for global dominance.

3.6. Conclusion

This third chapter has undertaken a thorough examination of China's economic evolution, its internal reshaping, and its global projection. Since the advent of economic reforms in 1978, China's economic scene has been remarkably transformed. Transitioning from a closed, centrally regulated system, it has emerged as the global manufacturing hub through exports of low value-added goods and significant investment levels, albeit at the expense of substantial inequality and restrained consumption. Yet, the limitations of this model have mandated a pivot towards an economy characterized by advanced technology and domestic consumption. While substantial strides have been made in this regard, China still faces significant challenges, both domestically and on the global front. On the one hand, Chinese progress towards a balanced economic model is inconsistent, as it still leans heavily on high levels of investment, constrained consumption due to a limited share of

household income, and significant inequality. However, China has shown considerable advances in technological and productive development and autonomy, climbing up the global value chains. This reality, coupled with China's increasing influence on the global stage, primarily through initiatives like the BRI or the AIIB, underscores its aspiration to redefine the international order.

The Chinese progression has elicited a reaction from the US, viewing Beijing's rise as a threat to its hegemony. Specifically, the US has made attempts to curb China's progression with various strategies, including a technology embargo targeting critical industries like semiconductor manufacturing. This move has triggered the onset of a technological war and the reinforcement of each country's stances, each striving to lead in the technologies of the Fourth Industrial Revolution, such as 5G, AI, or technologies linked to the energy transition. Therefore, despite the challenges on the horizon, China's rapid economic growth and expanding global reach suggest that its rise could signal a reshaping of the global economic power balance.

This fact indicates that China's ascent itself is implying a transformation of internal and external models that threatens US hegemony, especially in the technological domain. Consequently, the importance of examining whether China can indeed surpass the US as an economic hegemon stands out. On this foundation, the ensuing chapters (4, 5, and 6) lay the groundwork for addressing the central question of whether China can unseat the US as the premier hegemonic power by applying the three phases of the methodology delineated in Chapter 2: static-individual, static-structural, and structural-dynamic.

4. CAN CHINA OVERTAKE THE US HEGEMONY? A COMPARISON OF MATERIAL CAPABILITIES FROM A STATIC-INDIVIDUAL APPROACH

ABSTRACT

This chapter applies the first phase of the methodology outlined in this thesis, namely the static-individual analysis, to compare the material capabilities of China and the US across four key areas: production, technology, trade, and finance. By employing this approach, we aim to assess the potential for China to surpass US hegemony. By thoroughly examining the individual material capabilities of both nations, we present a comprehensive analysis of their relative strengths and weaknesses. Drawing on the existing literature, we critically discuss the implications of our findings and provide initial insights regarding China's rise and its prospects for overtaking the US. By employing a static-individual analysis, we lay the foundation for further investigation and draw preliminary conclusions regarding China's ability to challenge US hegemony based on its individual material capabilities.

4.1. Introduction

The previous chapter focused its analysis on China's remarkable economic transformation, observing how the country has evolved toward a model that bolsters its technological development and autonomy. This evolution has propelled China to a significant position within GVCs and equipped the country to compete in vital arenas of the Fourth Industrial Revolution, such as 5G and AI. This unprecedented progress has sparked an emerging debate on whether China is poised to succeed the US as the world's primary economic powerhouse.

In this fourth chapter, we will embark on the empirical phase of our research, employing the methodological framework established in Chapter 2 to explore the potential hegemonic transition between China and the US. Our primary goal is to ascertain whether China has the potential to supplant the US as the economic hegemon in the current global system, considering the multiple dimensions that constitute hegemony.

Since the end of World War II, the US has held a preeminent position in the international capitalist order, distinguishing itself through its material capabilities compared to other nations. However, China's integration into the international system, fueled by globalization, has facilitated its rise as a global power, sparking renewed discourse regarding a possible hegemonic shift.

In this phase of our research, we will put into practice the first phase of the methodology (the static-individual) introduced in Chapter 2. Together with the work done in Chapter 3, this approach will allow us to fulfill the second specific objective of our thesis: to examine in detail the characteristics and dimensions of China's rise in economic terms and to compare its individual capabilities with those of the US in order to evaluate and contrast the relative weight of both powers. This assessment will provide us with the tools to begin to answer a key question of this thesis: To what extent has China managed to catch up with or surpass the US in terms of individual capabilities in the productive, technological, commercial, and financial spheres? Furthermore, the analysis of the material capabilities of both countries provides valuable information to address the following questions of this thesis, which we will complete with Chapters 5 and 6.

In this vein, we will explore the four dimensions that constitute hegemony—production, technology, trade, and finance—and assess to what extent China has matched or overtaken the US so far. This analysis will form the basis for our subsequent chapters, where we will apply the second and third phases of the methodology (static-structural and

dynamic-structural) to contrast whether China's economic growth translates into a proportional increase in its structural power in the international system. In this line, our research will also lay the groundwork for subsequent examination of secondary hypotheses suggesting that China's growth in individual material capabilities has not resulted in a corresponding increase in structural power in key areas such as technology and finance. It's crucial to note that this analysis constitutes only part of our broader research approach. In subsequent chapters, we will utilize the findings of this analysis to investigate whether China's substantial economic growth translates into a proportional increase in its structural power in the international system, a central question in our primary hypothesis.

This chapter is organized as follows: Section 4.2 details the methodology and data sources that will be applied in this research. Sections 4.2.1 to 4.2.4 compare the material capabilities of China and the US in terms of production, technology, trade, and finance. Section 4.2.5 offers conclusions based on this comparison, providing a comprehensive assessment of the hegemonic positions of both countries. Section 4.3 discusses the chapter, evaluates some preliminary objectives, questions, and hypotheses, and lays the groundwork for the final analysis. Finally, Section 4.4 presents the final conclusions, summarizing key findings and addressing implications for the academic debate surrounding China's rise and potential as a hegemonic power in the international system.

4.2. Data and methodology

The methodological framework of our investigation is structured into three segments: static-individual, static-structural, and dynamic-structural. In the current phase, we will apply the static-individual analysis. Specifically, as we described in Chapter 2 in detail, we will dissect the individual material capabilities of each nation across four key spheres:

productive, technological, commercial, and financial.

First, productive hegemony reflects a country's ability to generate goods and services and its overall influence within the global productive landscape. To scrutinize this segment of hegemony, it is paramount to explore various dimensions that provide intricate details about the economies of both countries, focusing on the most significant indicators within this realm.

To this end, we will analyze each country's GDP based on Purchasing Power Parity (PPP), in constant terms, per capita (PPP and constant terms), and per worker employed (a proxy of productivity), using data from the World Bank (2023). Analyzing the GDP in terms of PPP, constant values, per capita, and per worker offers a snapshot of the robustness of the productive sector in each country. The absolute indicators provide a panoramic view of the economy, reflecting its overall size, while the relative indicators, such as per capita GDP, offer an intensive picture of economic development, enabling us to evaluate the distribution of wealth among a country's inhabitants. Specifically, labor productivity per employed person becomes a crucial barometer for gauging the efficiency of production in each economy. This indicator reveals how each nation can generate value from its labor resources and can shed light on the efficacy with which economies utilize their workforce.

Additionally, each country's contribution to the global value-added industry (World Bank data) serves as a parameter that helps gauge a country's role in the global production of goods and services. Such economic dominance can reverberate throughout the global economy, as fluctuations in the economy of a dominant country can significantly impact the world market. For instance, if China, with a heavier industrial weight, undergoes economic contraction, the global demand for raw materials might decrease, impacting raw material-exporting countries. Conversely, rapid growth in such

an economy could stimulate growth in other parts of the world due to increased import demand.

Equally, the relevance of major corporations in the global economy is a critical aspect to consider when analyzing a country's productive hegemony. Data like the Forbes Global 2000 (Forbes, 2022) list, which includes sales, profits, assets, and market value of companies in both countries, offer a detailed view of the productive capacity of the most influential corporations and their impact on the global economy. Observing these metrics, we can appreciate the level of economic activity generated by these large corporations and how they influence the global economy. Their size, profitability, and market value not only reflect their commercial success but also their ability to influence economic development, market trends, and industrial policies. Their power and influence can have ramifications on labor standards, technological innovations, sustainability practices, and other critical aspects of production.

Also, trademarks and industrial (WIPO, 2023) designs registered overseas are essential indicators of intellectual property that provide a unique perspective on each country's innovative capacity and how they protect and value internally generated ideas. These overseas registrations evidence the global projection of the economies in question, displaying international recognition of their productive capacity. This aspect highlights each country's ability to produce high-value-added goods and services that gain recognition in the global economy. Being registered overseas, these designs and trademarks reflect an economy where innovation is not only valued but also capable of crossing borders. This is indicative of the global influence of the country and its potential to set international trends and standards.

Finally, FDI (World Bank, 2023) is a key factor in the world economy, as it represents a significant part of global capital flows and often brings not only financial

resources but also technology transfer, management know-how, and access to new markets, a key factor in the productive area.

FDI inflows indicate the extent to which a nation is considered an attractive destination for production and investment, suggesting a favorable business environment, access to resources and markets, and potential for profit. High levels of inward FDI could indicate a country's strong productive capacity and potential for economic growth.

Conversely, outward FDI from a country indicates that its firms are expanding their reach into the global economy. High levels of outward FDI suggest that the country's firms are influential players on the global stage, capable of driving production and setting standards around the world. This reflects a nation's external economic influence and is a crucial part of its productive hegemony.

FDI is thus a crucial indicator in our analysis, as it sheds light on a country's productive prowess, its attractiveness for investment, and its influence on global production networks.

Within the scope of technological hegemony, assessing a country's ability to lead in pivotal arenas of research, development, and innovation, our attention is honed on indicators that gauge each country's technological leadership, fostering a comprehensive understanding of the techno-dynamic landscape.

The first indicator under our lens is the output of knowledge- and technology-intensive industries (KTI). This measure illuminates each country's stance within sectors demanding substantial research and development (R&D) investment. The capacity to drive technological breakthroughs in these sectors mirrors a nation's potential for economic growth and its competitive global position. The vital contribution these sectors bring to technological hegemony is crucial, given their role as incubators for innovative technologies that can potentially reshape the industrial landscape. The source for this

indicator is the National Science Foundation (2022).

Subsequently, we evaluate the value added in R&D-intensive industries. This index quantifies the value generated in these sectors after factoring in input costs, representing a measure of each country's efficiency in transforming R&D investments into valuable products and services. This indicates their potential to convert technological competence into tangible economic benefits. The capability to create high-value-added goods and services characterizes a country's technological dominance, capturing the economic impact of innovation. The source for this indicator is the National Science Foundation (2022).

Further, we contemplate R&D expenditure as a percentage of GDP (OECD, 2023). This metric signifies a country's dedication to innovation, a keystone of technological competitiveness. It offers a comparative scale of the magnitude of each country's investment in technological advancements, thus determining the tempo of its innovation race.

The number of patents granted, both domestically and internationally, serves as a critical indicator of a country's innovative capacity (WIPO, 2023). Domestic patents granted are indicative of a country's potential to generate novel and useful ideas. In contrast, foreign patents granted demonstrate the global influence and recognition of these innovations, reflecting a country's capability to export its technology and shape global innovation trends.

In tandem, we scrutinize the revenue derived from intellectual property use (World Bank, 2023). This metric offers insight into a country's ability to monetize its technological innovations and influence global markets, thereby mapping the financial benefits gained from technological advancements.

The Human Capital Index (data from Feenstra et al., 2023). is analyzed to gauge

each country's ability to nurture and evolve the talent necessary to sustain competitiveness in the technological arena. Cultivating human capital is integral to technological hegemony, as the workforce's quality and skills often dictate the pace and scope of technological advancements.

Lastly, to identify leadership in emerging technologies, we explore 5G patent holders, the degree of development in AI, the chip industry, and strides in energy transition. These measures reveal each country's position in developing and deploying key technologies destined to shape the next innovation frontier. Their capability to lead in these future-defining areas mirrors their preparedness for the forthcoming technological era. We use 5G patent data from Kim et al. (2020), AI data from Castro et al. (2021), and The Economist (2023). The 5G standards data are from IPlytics (2022). Chip industry data are from (Kearney, 2021; Feás, 2023), and those linked to energy sources are from BloombergNEF (2022).

In the third segment of our study, we focus on trade hegemony, which scrutinizes a country's influence and power in terms of international trade relationships, market access, and its position within global supply chains.

For trade hegemony, we initially contemplate the world trade in goods and world trade in services using data from the United Nations Commodity Trade Statistics Database (COMTRADE, 2023). This indicator serves as a crucial determinant as it offers a snapshot of each country's transaction volume within international markets, thereby reflecting its influence and participation within the global economy. A country with a significant share in world trade of goods and services has a commanding role in global trade, granting it the power to influence trade patterns, norms, and international agreements.

Subsequently, we examine each country's exports to each region (COMTRADE).

This measure is vital to comprehend each country's geographic sphere of influence. For instance, if China exports considerably to Africa, it could indicate substantial economic influence on that continent. Similarly, if the US exports extensively to Europe, it suggests a strong influence within that region.

The subsequent measure under consideration is the number of trading partners having China or the US as their primary trading partner. This metric gives us an insight into each country's trade network's extent and its ability to influence the global economy. A country with numerous trading partners has a higher likelihood of influencing global trade rules and policies.

Further, we analyze trade in terms of value-added using OECD data, specifically the Trade in Value Added (TiVA): Origin of value added in gross exports. This measure refers to the additional contribution a country makes to its exported goods and services, factoring in the value of imported intermediate inputs. It enables us to understand each country's stance in global value chains and its capacity to capture value in these chains' highly profitable stages. Essentially, this indicator illustrates how a country can enhance the value of the goods and services it exports, which signifies economic competitiveness and sophistication.

By compiling and analyzing all these indicators, we obtain a holistic view of the trade hegemony of China and the US. This allows us to understand how each country's influence in world trade has evolved over time and how they have navigated the global economy. Thus, we gain a deeper understanding of the power dynamics in world trade and potential future shifts.

In the fourth segment of our study, we concentrate on evaluating financial hegemony, which symbolizes a nation's power and influence within the global financial system. We execute our empirical analysis of financial hegemony between the US and

China using several pivotal indicators, facilitating an assessment of each nation's standing within the global financial system and its capacity to shape it.

Initially, we evaluate the size, structure, and share of the Chinese and the US. Financial markets within the global equity spheres using data from Statista (2023) and for supranational, sovereign, and corporate bonds using data from the International Capital Market Association (2023). These measures provide a depiction of each nation's significance within the global financial architecture, reflecting its capacity to guide global financial flows.

Subsequently, we scrutinize the composition and evolution of global foreign exchange reserves using IMF data (IMF, 2023). This exploration offers insight into the relative importance of both countries' currencies within the international financial system and the influence their currencies exert worldwide.

In our third step, we use data from SWIFT and BIS to contrast the usage of different currencies - specifically, the US dollar and the Chinese yuan - in global payment transactions and within the foreign exchange market. These indicators facilitate an understanding of the preference for Chinese and US. Currencies in international trade and financial investments. The prevalent use of a currency in global transactions indicates the weight of each currency in world trade. Next, we investigate the current account balances. The current account balance indicates a country's trade balance and its net income from abroad (World Bank, 2023).

By applying this methodology, we acquire a detailed vision of China's and US' financial capabilities and how these capabilities influence their position within the global financial system. Based on this empirical analysis, we can ascertain whether China's growth poses a challenge to the financial hegemony of the US dollar.

4.2.1. Productive hegemony

This section will focus on evaluating the productive hegemony of China and the US. First, China has overtaken the US as the world's largest economic power in terms of GDP in purchasing power parity (Figure 6), with China's GDP representing 10% of that of the US in 1990 and 117% today. However, it is still behind if measured in constant dollars (World Bank, 2023), as China's GDP is currently 77% of that of the US. However, the main difference between the two countries lies in GDP per capita (Figure 7). In PPP terms, US GDP per capita is over $65,280 compared to China's $16,784, which places the latter in the middle-income group (World Bank, 2023). Specifically, in PPP terms, in 1990 China's GDP per capita was 3.5% of that of the US compared to 27.64% today. In constant terms, the current figure is 18%.

Regarding growth, according to World Bank data, China's average growth rate has been 10%, compared to 3.05% for the US from 1980-2007, and 7.5% vs. 1.66% between 2008 and 2021. In this regard, China's growth rates are expected to decrease in the future, but they will continue to outpace those of the US (Li, 2017).

Figure 6. Relative share of China's GDP compared to US
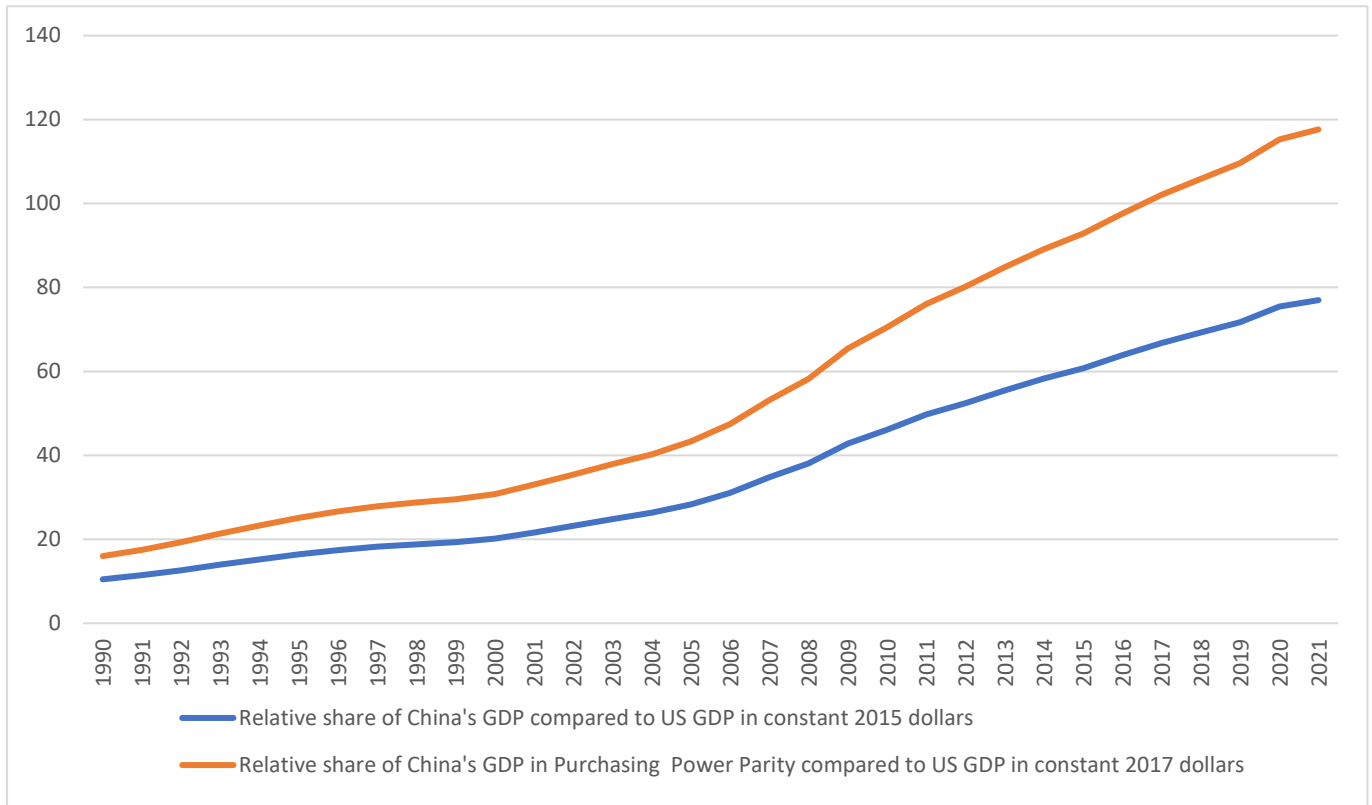
Source: World Bank (2023)

Figure 7. Relative share of China's GDP per capita compared to US
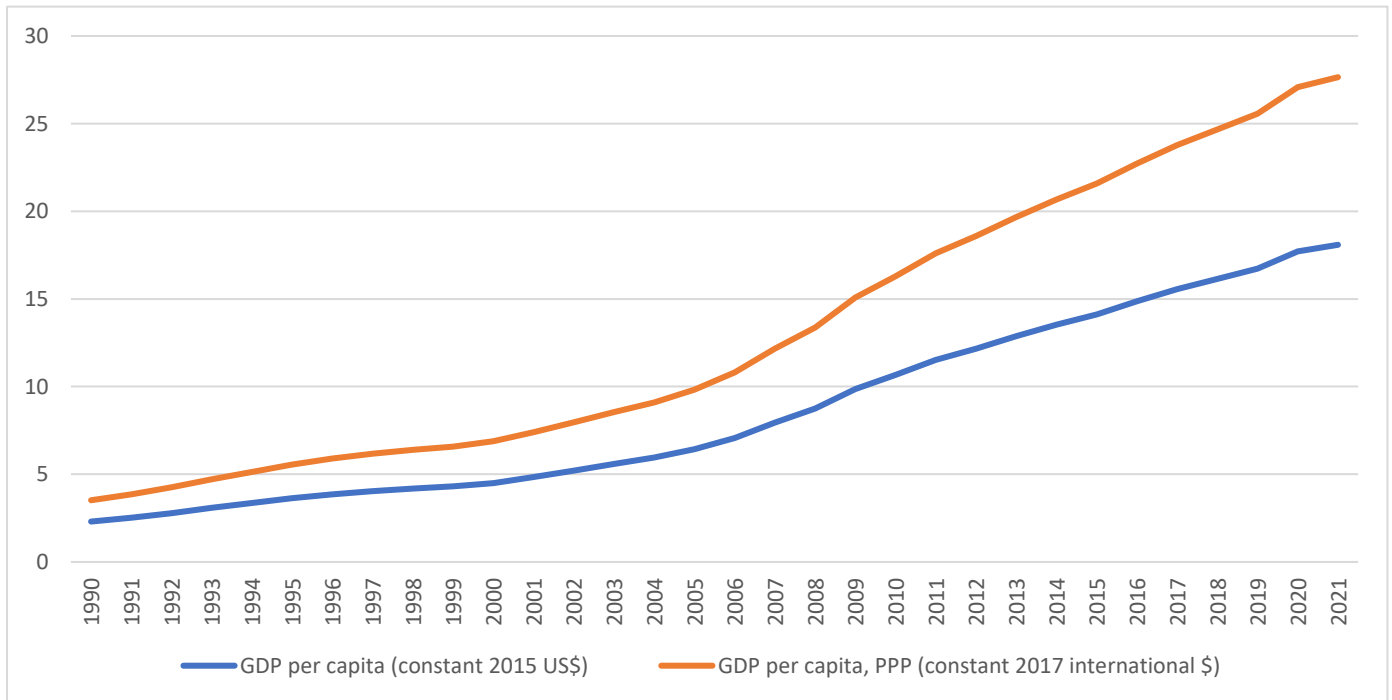
Source: World Bank (2023)

On the other hand, Figure 8 shows productivity per person employed, which reflects a significant difference between the two countries. China has gone from accounting for 3% of US productivity in 1991 to 24.83% in 2021. Overall, the transformation of the Chinese economy has enabled its productivity to reach 80% of world productivity in 2021, up from 11% in 1991 (World Bank, 2023). Zhu, Zhang, and Peng (2019) indicate that productivity growth in China will follow a gradual downward trajectory as it approaches the global productivity frontier. This aspect is essential for the Asian country, as it is transforming its productive model towards a more intensive and less extensive one, increasing productivity per person employed given the slowdown in population growth (Vázquez, 2022).

Figure 8. China labour productivity (GDP per person employed in 2017 constant dollars) relative to US
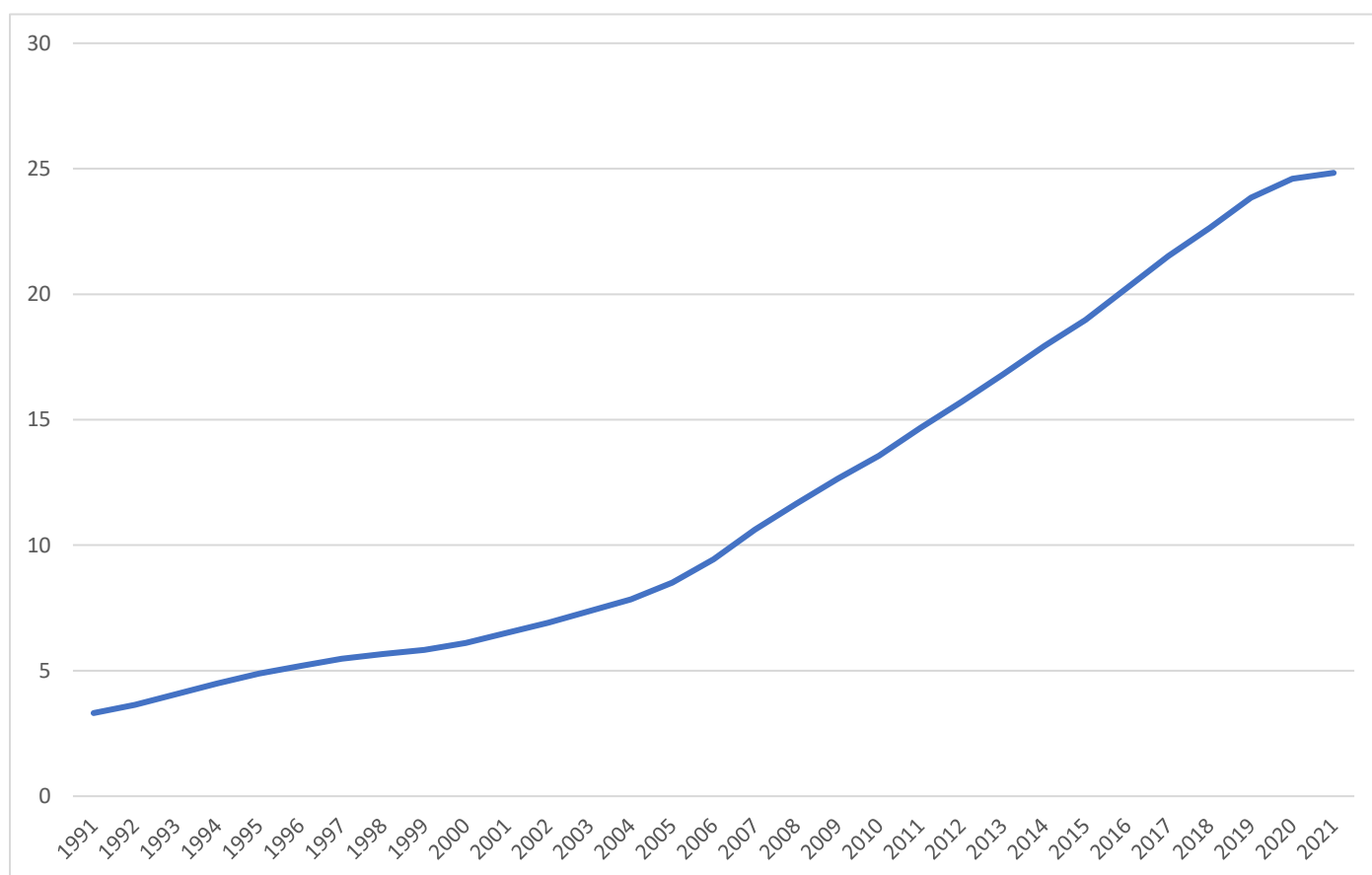
Source: World Bank (2023)

Turning our attention to Figure 9, it is evident that in terms of industrial contribution to global value-added, China overtook the US in 2009. By 2021, China's contribution was twice that of the US, comprising 30% compared to the US' 15% of the worldwide total.

Figure 9. Value added of the industrial sector as a world percentage.
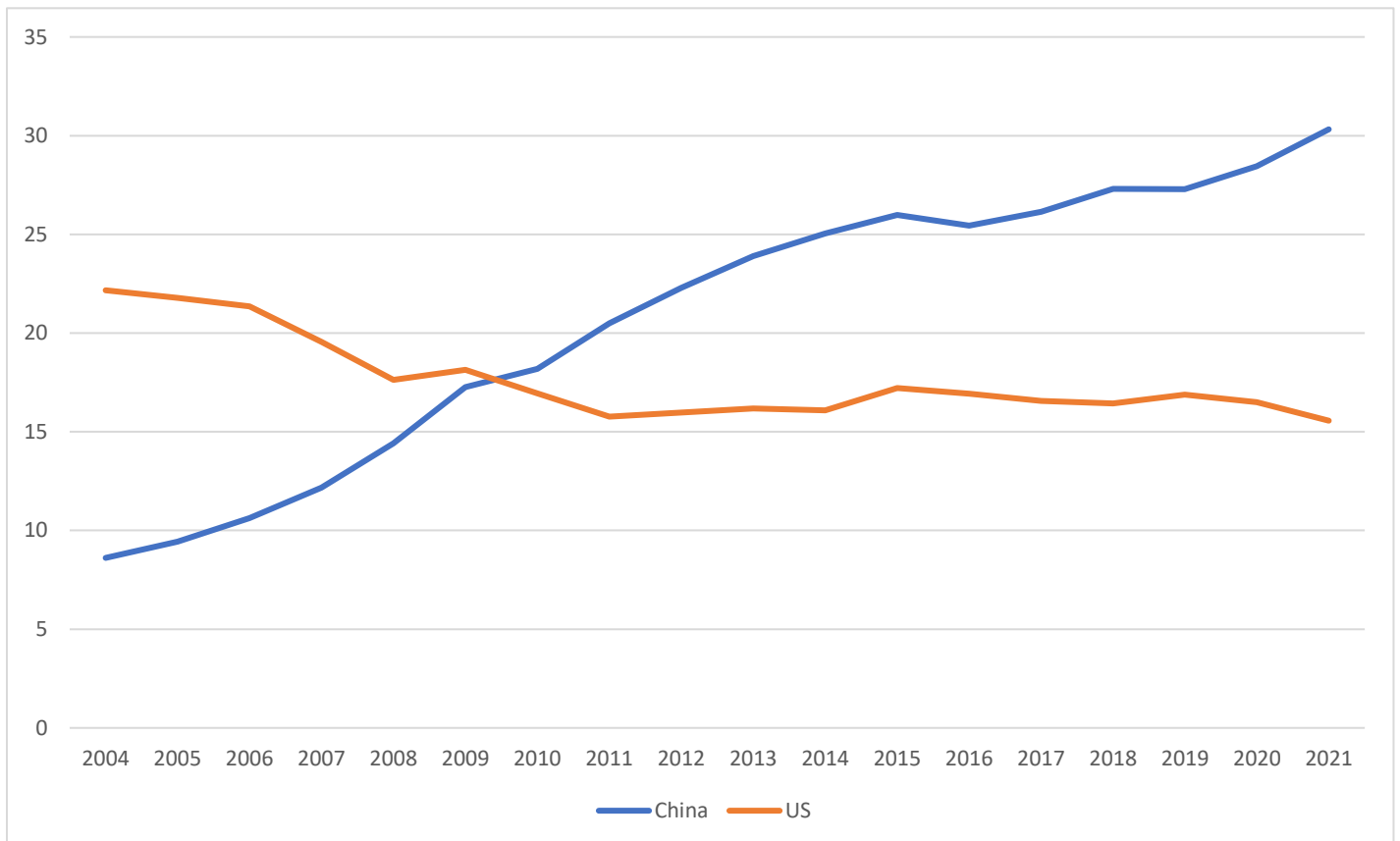
Source: World Bank (2023)

Regarding the size of companies (Figure 10), Forbes Global 2000 data ranks the world's largest companies using four parameters: sales, profits, assets, and market value. In 2022, China had 297 companies among the world's top 2000, compared to 584 for the US. Specifically, in terms of total sales in dollars, Chinese companies achieve $8,295,172 million compared to $15,206,451 million for American companies, for profits of $651,254.9 million compared to $1,853,443.5 million, for assets $51,883,437 million

compared to $55,313,763 million, and for market value $6,839,165 million compared to

$38,185,028 million, respectively.

Figure 10. Forbes Global 2000. Total sales, profits, assets and market value of China and US companies in millions of dollars
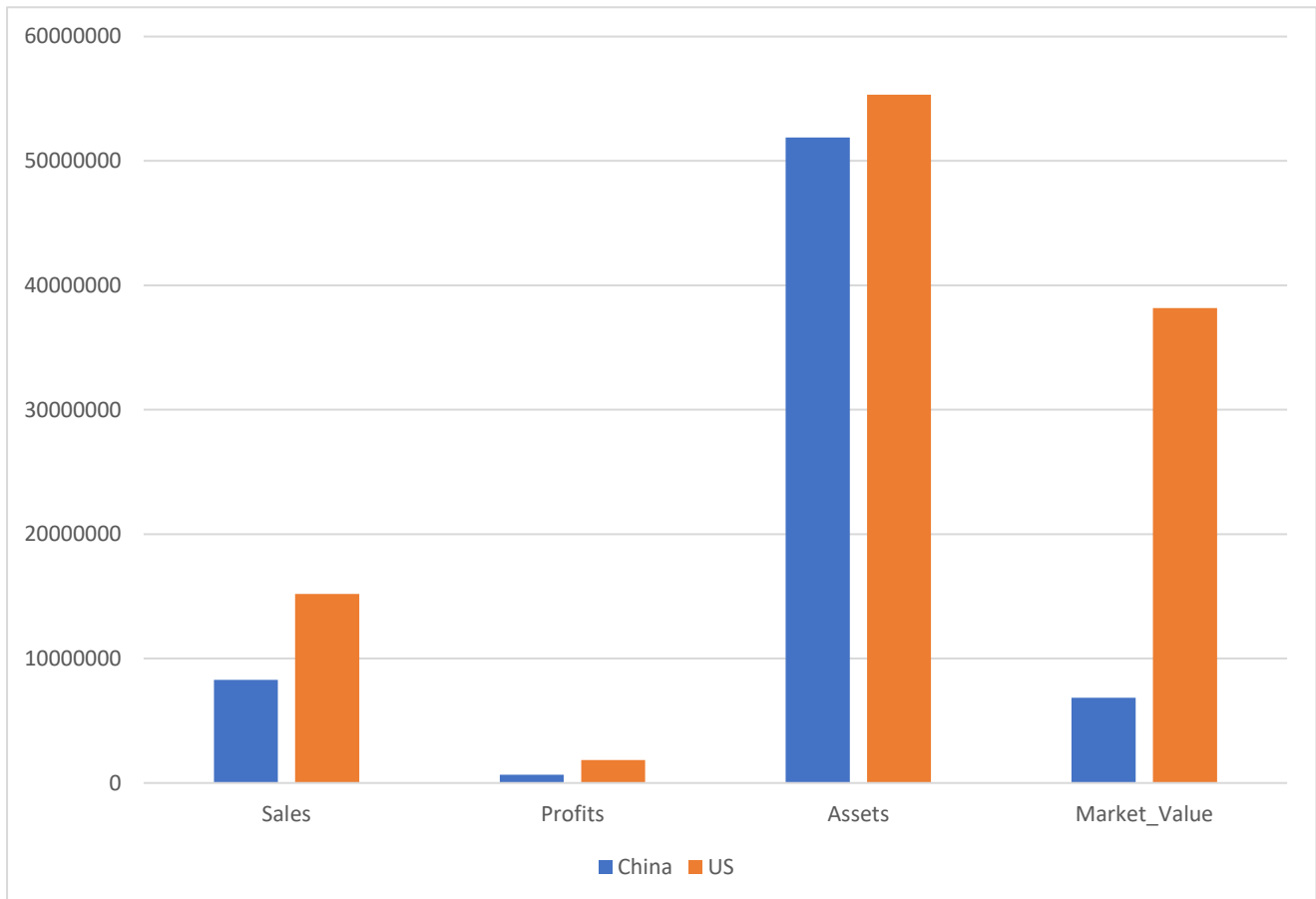
Source: Forbes Global 2000 (Forbes, 2022)

Figure 11: Trademark registered abroad.
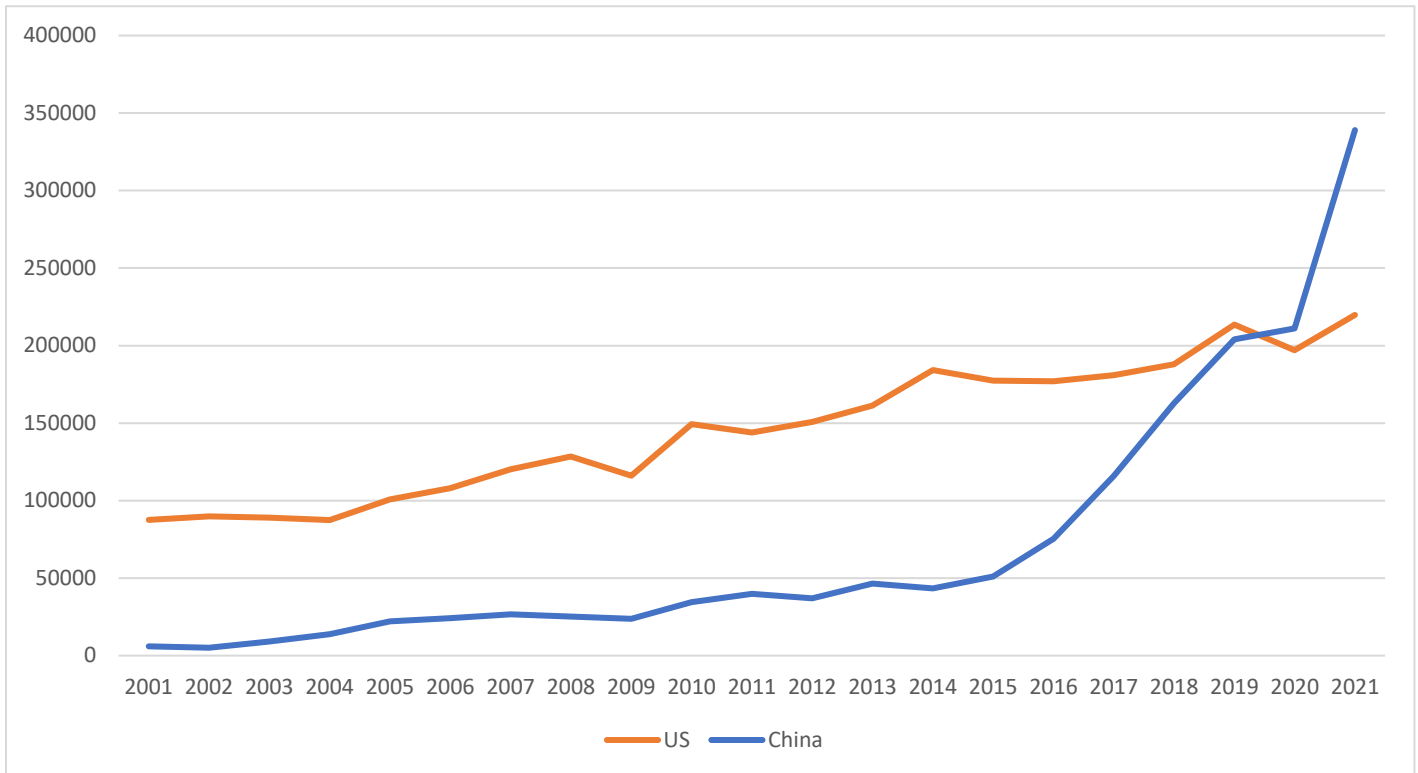
Source: WIPO (2023)

The WIPO data in Figures 11 and 12 show that China surpassed the US regarding foreign trademarks and industrial designs registered in 2021. Regarding trademarks registered abroad, the figures show that China has taken the lead, which can be interpreted as an indicator of increasing productive capacity globally. Trademarks registered abroad are critical for international market recognition and penetration and provide a unique identity to companies in the market, strengthening China's ability to produce and export innovative and high-quality goods and services. China has also surpassed the US in 2021 regarding overseas registered industrial designs. Industrial designs protect a product's aesthetic appeal, a factor often decisive in consumer purchasing decisions, and ensure the preservation of competitive advantage. China's advancement on both indicators reflects the growing dynamism of China's productive apparatus and the success of its policy aimed at developing, protecting, and capitalizing on innovative intangible assets in global markets.

172

Figure 12. Industrial design registered abroad.
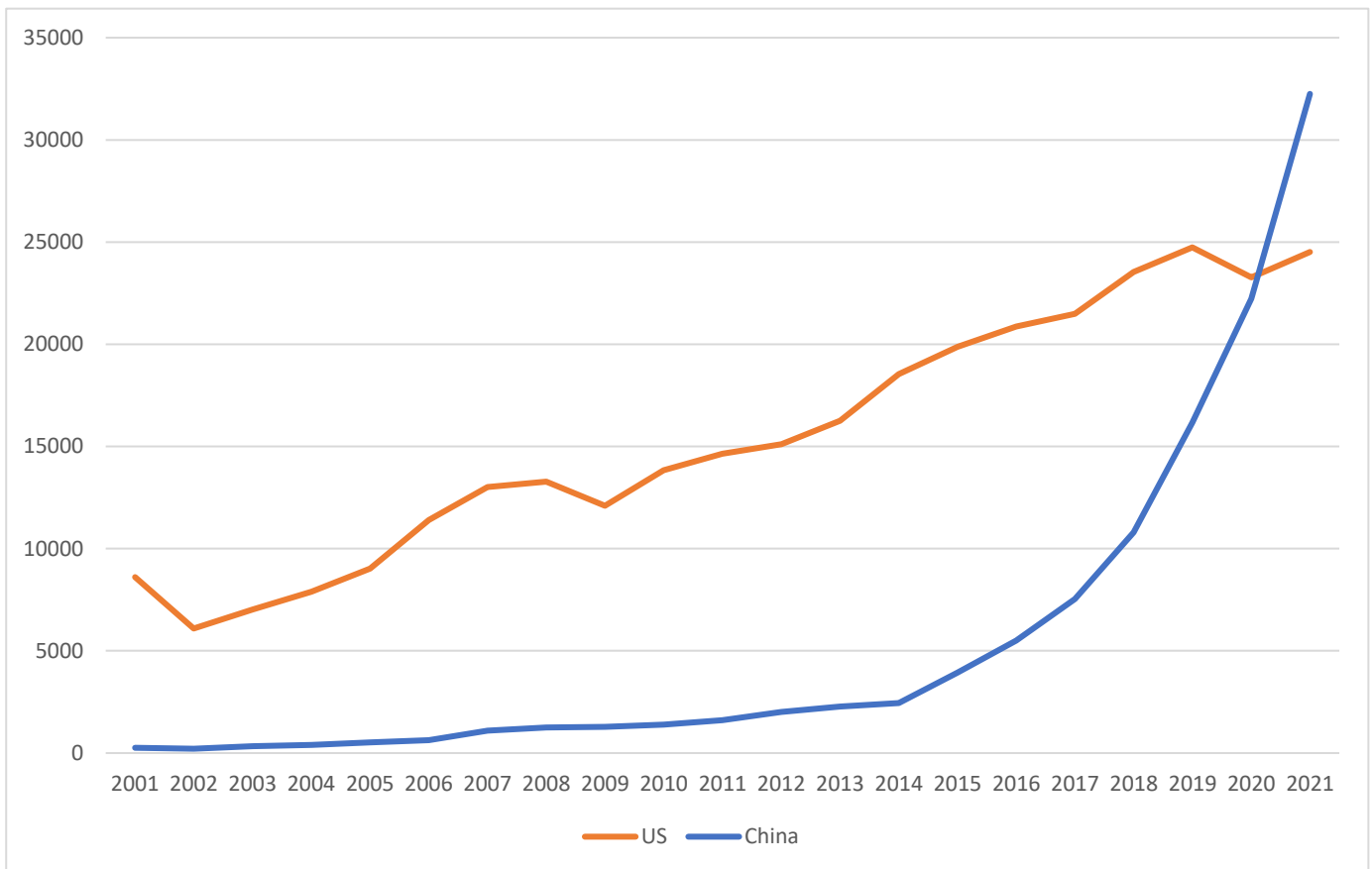
By analyzing FDI inflows and outflows (Figures 13 and 14), we can determine the position and influence of both China and the US in the global production landscape.

Starting with FDI inflows, the US began the 21st century with a significant advantage over China, marking it as a more attractive destination for investment and production. This advantage not only suggests the presence of a favorable business environment in the US but also indicates its robust and productive capacity and economic growth potential.

However, China experienced remarkable growth in its FDI inflows over the years. From 2001 to 2021, China's FDI inflows grew by about 609%, making it an increasingly attractive investment destination. In 2021, China's FDI inflows even surpassed those of the US. The significant increase in FDI in China is indicative of its growing productive capacity, the development of a favorable business environment, and its increasing

integration into global production networks.

Figure 13. FDI inflows
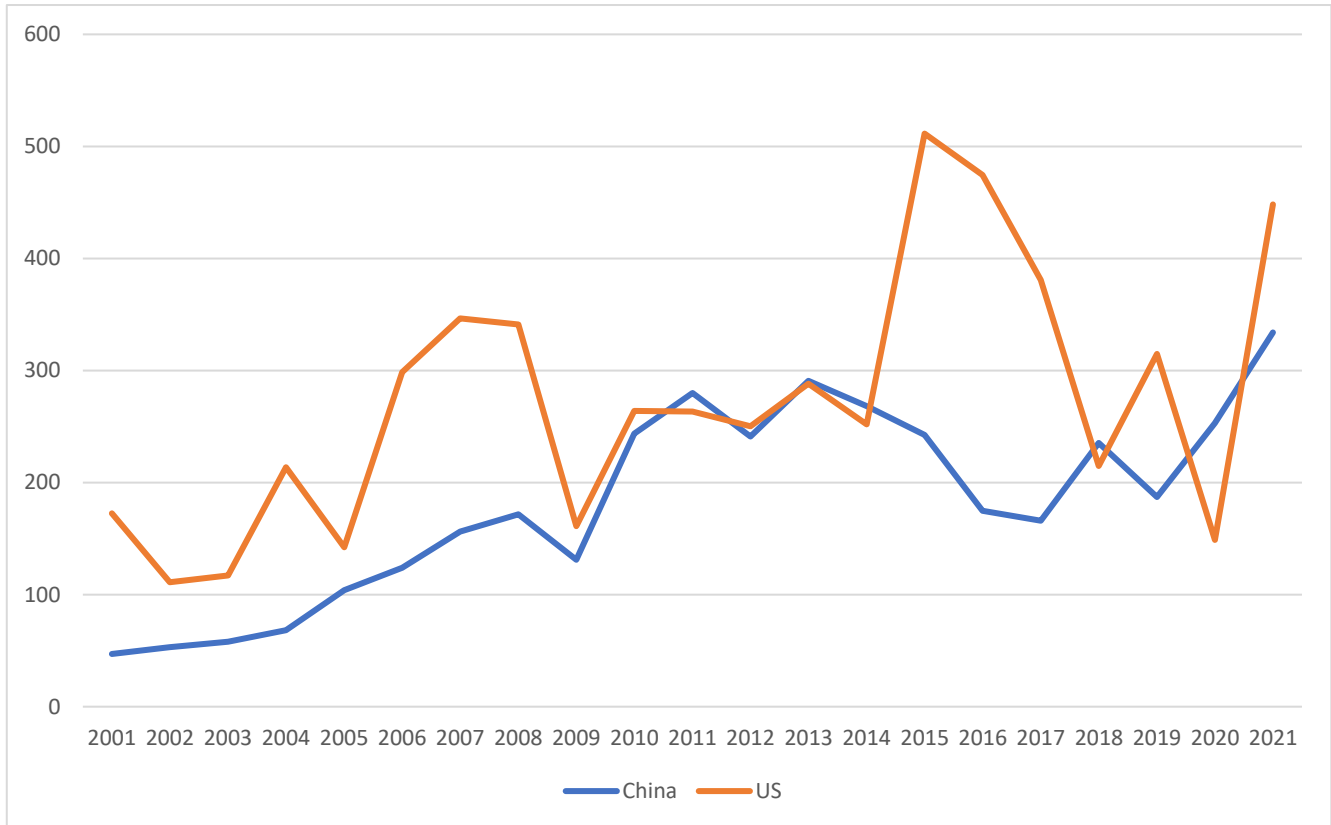
In terms of outward FDI, the US generally showed a higher level of outward FDI than China. This means that the US companies were expanding globally, investing in overseas production, and boosting their productive clout on the world stage. Despite experiencing growth in its outward FDI over the years, China remained significantly behind the US, suggesting that although Chinese firms have become more active globally, they may still need to exert the same level of influence as the US firms.

Thus, although the US continues to play a leading role in outward FDI, it has seen its position as the leading destination for inward FDI challenged by China. At the same time, the increase in China's inflows indicates its growing importance as a global

production center. The trends suggest a narrowing of the gap in production hegemony between the two countries, with China's growing attractiveness for investment and the continued global influence of the US companies shaping the dynamics of world production.

Figure 14. FDI outflows
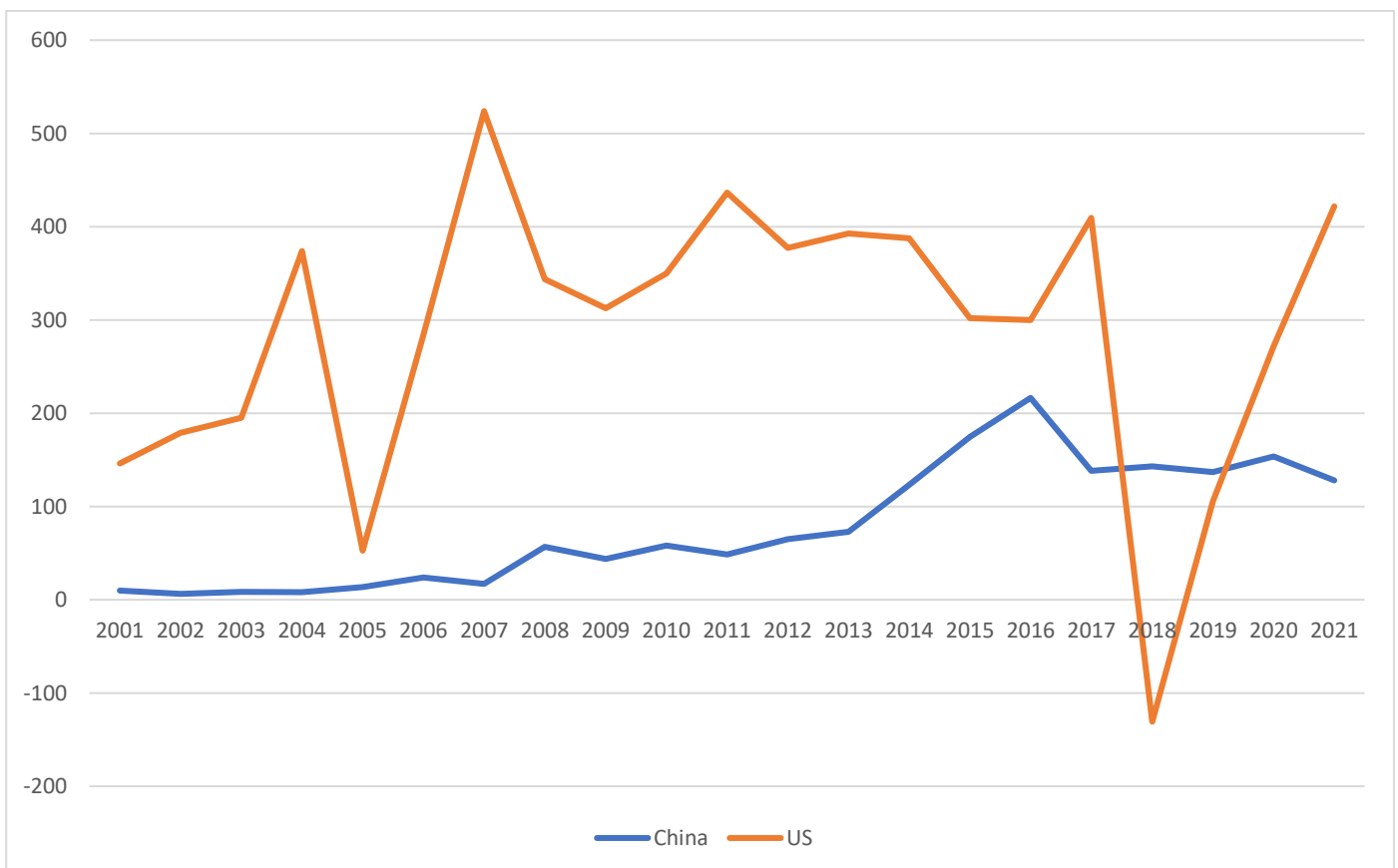
Source: World bank (2023)

In summary, despite China surpassing the US in GDP (in PPP) and contributing to global industrial value added, it trails in GDP (in constant terms), productivity, and GDP per capita. These metrics reflect a more efficient economy and advanced production model in the US. Although China has made substantial progress, its economy has been characterized by extensive rather than intensive growth, with better performance in absolute terms when contrasted with per-capita proportions, a factor influenced by its vast

population size. In this vein, a change in the production model will be decisive in further reducing this gap, as the model that has allowed China to become one of the world's leading economies based on low value-added exports and high investment rates begins to reduce its returns (see Chapter 3). Therefore, the goal of raising the GVCs and developing the country's high-tech sectors is critical to driving more intensive growth and staying in the race with the US.

Concerning the global impact of companies from each nation, the landscape appears balanced. In sales, profits, and assets metrics, companies from both countries have considerably narrowed their disparities, though the US maintains a lead. The most significant contrast lies in the market value of US companies, which far exceeds their Chinese counterparts. However, Chinese enterprises have recently surpassed US firms regarding overseas registered trademarks and industrial designs. These are critical indicators of a country's ability to compete in global markets, suggesting that China is aggressively investing in its capacity to produce high-quality goods and services internationally. Also, the increase in trademarks and industrial designs reflects the Chinese ability to change its production model and its position in the GVCs. However, to surpass the US in cumulative total, China needs to surpass more years the US levels.

The FDI data between China and the US further reinforces these observations. Although both countries have seen similar FDI inflows, reflecting their attractiveness as destinations for global production and investment, the US still leads in FDI outflows. This differential suggests that US firms have a more significant influence in shaping the global productive structure. High levels of outward FDI from the US indicate that its corporations are expanding their reach, driving production, and setting standards worldwide. This expansion underscores the US' external economic influence and highlights its productive hegemony. Despite Chinese corporations' growth and increasing

176

international footprint, US companies still have a more prominent role in dictating global production norms and standards.

Thus, China has outpaced the US in absolute or extensive terms, such as in PPP GDP size, industrial production, and intellectual property registrations. However, on a relative or intensive scale, the US remains superior, underscored by its higher productivity and per-capita GDP. Moreover, US companies are more predominantly featured in the upper echelons of the Forbes Global 2000 list. The future of productive hegemony will be shaped by China's ability to sustain growth rates exceeding those of the US and by generating more intensive growth, thereby further augmenting productivity and GDP per capita.

In conclusion, while China has made impressive progress in enhancing its productive capacity, it still faces significant challenges in improving efficiency, fostering sustainable development, and advancing innovation. Despite being challenged regarding productive capacity, the US continues to lead in economic efficiency and company market value. However, China's emerging trend in overseas intellectual property registrations could indicate a future shift in the balance of economic power.

4.2.2. Technological hegemony

Regarding the analysis of technological hegemony, we evaluate progress in research and development (R&D), innovation, patent acquisition, and participation in leading-edge industries. We focus on knowledge- and technology-intensive industries (KTI), examining the value-added that both countries contribute to these industries and their performance in R&D-intensive industries. We also consider specific aspects of technological rivalries, such as developing and deploying essential technologies in the

Fourth Industrial Revolution, including 5G, artificial intelligence, energy transition, and semiconductor advancement and manufacturing.

Data from the National Science Foundation (2022) show a significant shift in the global dynamics of knowledge- and technology-intensive industries (KTI). China has overtaken the US in value-added production in the manufacturing sector of KTI industries, indicating a shift toward Asia in the balance of technological power (Figure 14). However, the US still leads in the services sector and the more R&D-intensive KTI industries, although China has narrowed its gap over the past decade (Figure 15).

These results underscore the dynamism of KTI industries and competitiveness in the global landscape. They highlight the significant advance of China, especially in manufacturing, while the US maintains its dominance in services and more R&D-intensive industries.

This evolution has implications for both productive and technological hegemony at the global level. China's emergence as a critical country in high-tech manufacturing suggests a shift in the balance of power in the global technology sector. In addition, its growth in R&D implies a potential to lead in emerging areas of technology. Finally, its progress in the service sector could indicate a developing ability to compete in the global science and technology-based service economy.

Figure 14. Output of KTI industries for selected region, country, or economy, by sector: 2010 and 2019 billion of dollars
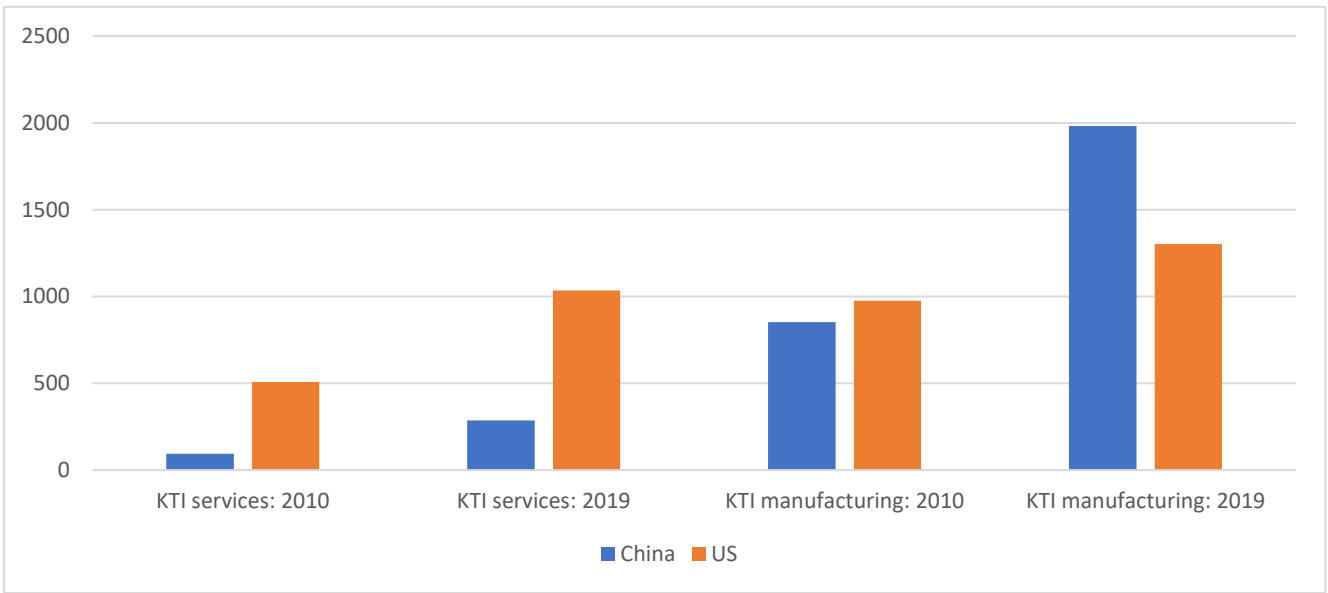
Source: National Science Foundation (2022)

Figure 15. Value added of high R&D intensive industries: 2002–18 (Millions of current dollars)
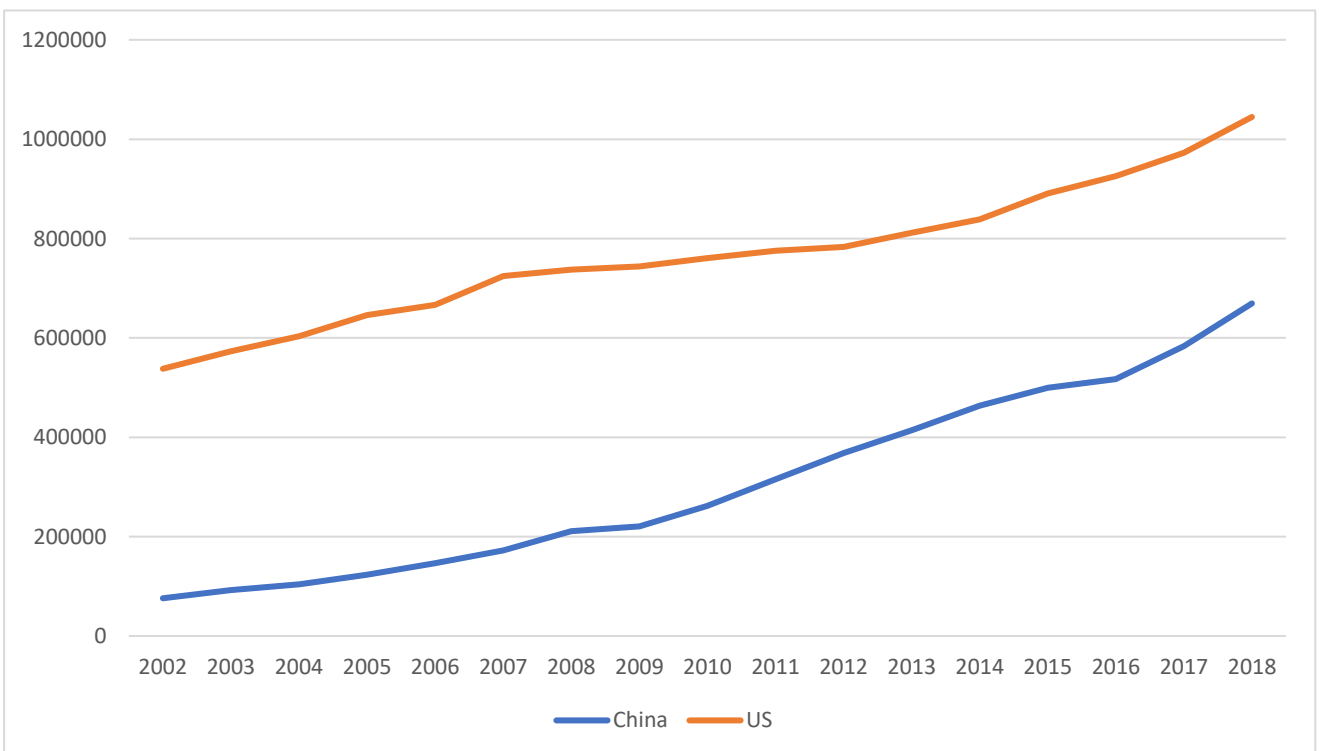
Source: National Science Foundation (2022)

China's growth in these industries is clearly linked to the data shown in Figure 16, as it has been reinforced by a substantial increase in investment in research and development (R&D), which has reached 2% of GDP (Figure 16). However, the US continues to lead in R&D spending, approaching 3.5%.

Figure 16. Gross domestic spending on R&D as % of GDP.
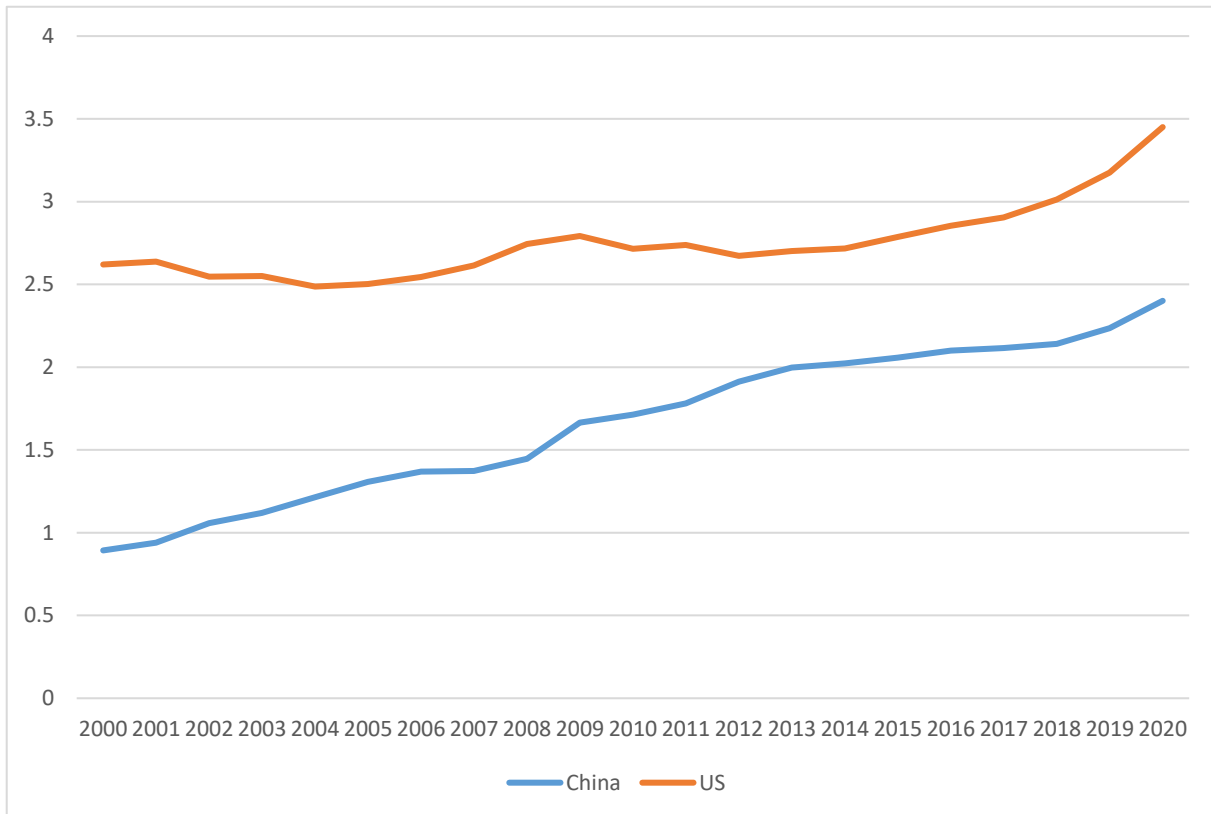
Source: OECD (2023)

This technological progress has enabled China to surpass the US in total registered patents (Figure 17). However, when examining patents registered in other countries, China has a significantly lower number than the US (Figure 18). This suggests that most Chinese patents are concentrated domestically and face challenges in internationalization (In Chapter 5, we will extend this analysis by applying Phases 2 and 3 of the methodology in the technological area). These obstacles include issues with patent quality and the adoption of Chinese technologies and standards abroad. However, despite China's

advances in IPRs worldwide (trademarks, patents, or industrial design), the US continues to lead in receipts for charges for the use of intellectual property (Figure 19).

The connection between these data points becomes prominent when considering the role of human capital (Figure 20) in maintaining and developing a nation's technological and competitive capabilities. Measured by years of schooling and educational attainment, the US outperforms China, scoring 3.7 versus 2.7 (Feenstra et al., 2023). This factor is crucial for fostering a robust environment for innovation and technological advancements.

Figure 17. Number of patents grant by country in 2001-2021.
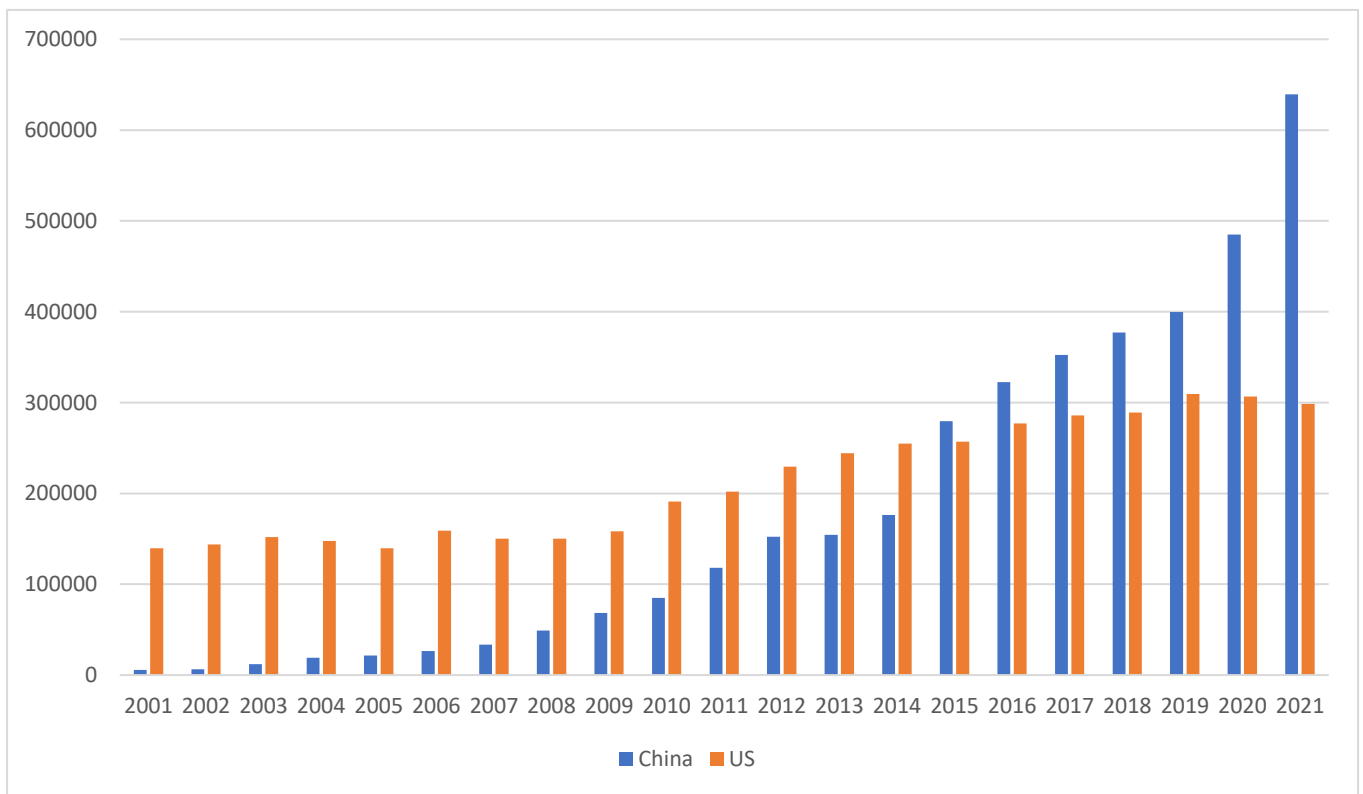
Source: World Intellectual Property Organization

When examining the technological development of both nations, the Global Innovation Index (2020) places the US and China in third and 14th places, respectively. However, among middle-income countries, China leads the ranking. The specific aspects

the index evaluated as indicators of innovation leadership reflect this positioning. For example, in the sub-classifications of institutions and infrastructure, China ranks 62nd and 36th, while the US ranks 9th and 24th. In the sub-classification of innovation and technology production, China reaches the seventh position, compared to the third position occupied by the US.

Figure 18. Number of grant patents abroad 2001- 2021
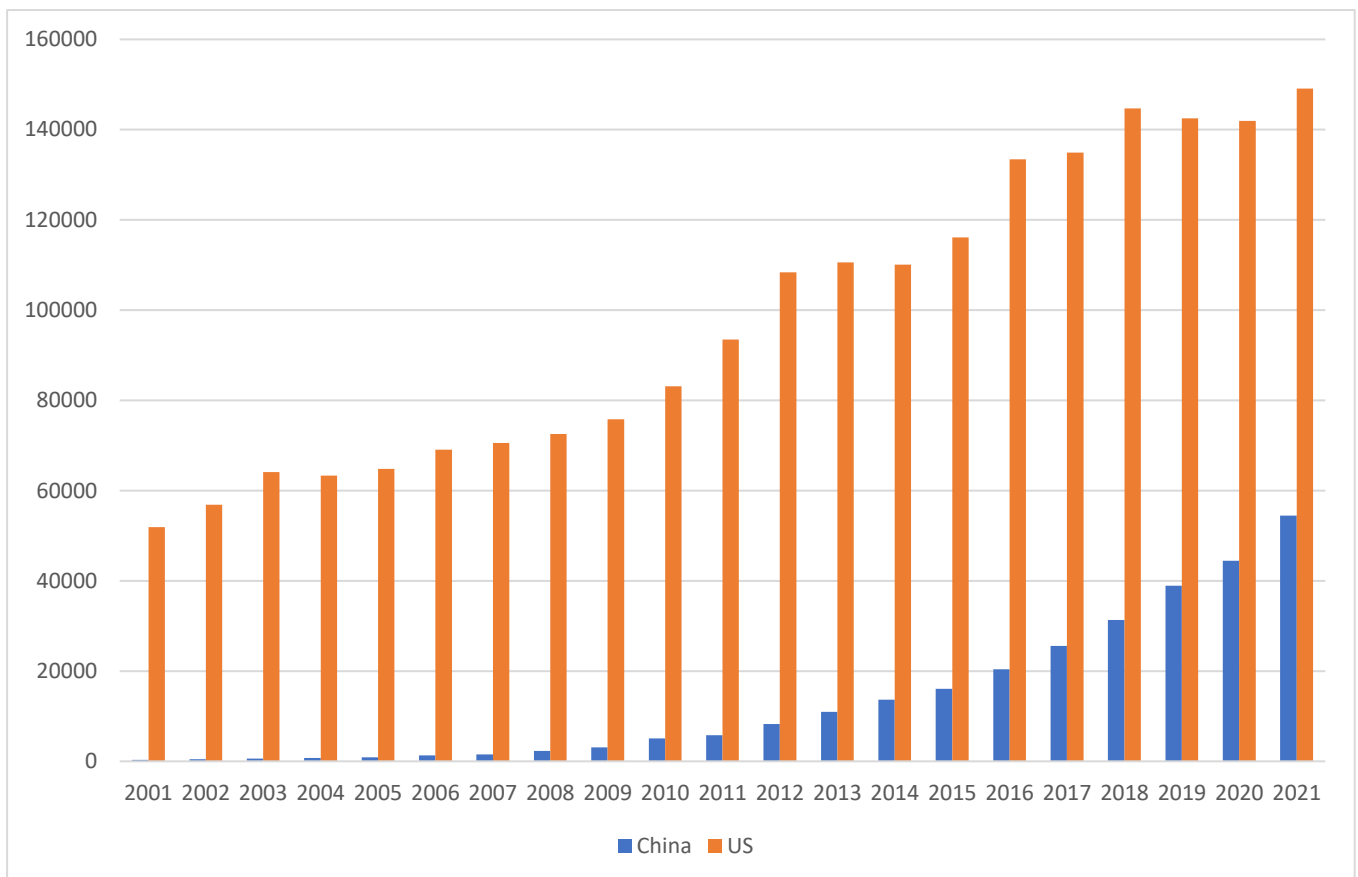
Source: WIPO (2023)

Figure 19. Charges for the use of intellectual property, receipts in current US$
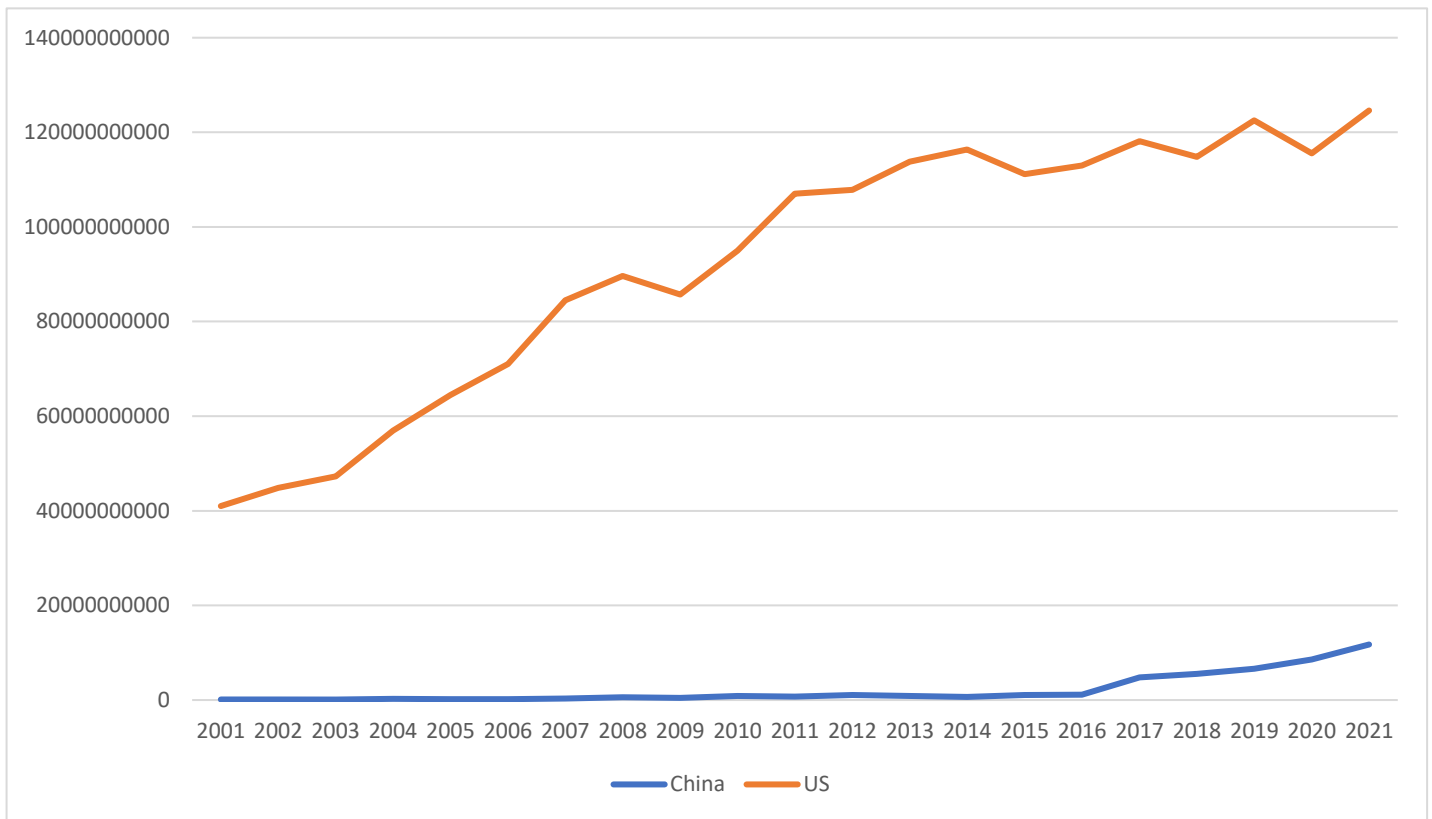
Source: World bank (2023)

On the other hand, publishing research in the peer-reviewed literature is essential for the diffusion of new knowledge in Science and Technology (S&T), driving invention and innovation. Of all global S&T publications, China produces 23%, and the US 16%. From 2000 to 2020, the growth in publication output of China, an upper middle-income country, outpaced the US, a high-income country, with an average annual growth rate of 11% versus 3%, respectively. In terms of research priorities, in the US, the majority of articles were in the field of health sciences, while in China, the most substantial proportion were in engineering. Despite this faster growth in China, US publications were highly impactful in citations, contributing almost twice as many highly cited articles as expected, given their total publication output, maintaining an index of around 1.8. China's index increased from 0.4 to 1.2 (National Science Foundations, 2022).

Specifically, the technological conflict between China and the US (Vlados, 2020) has centered on developing 5G technology and advancements in Artificial Intelligence. The race for leadership in these technologies is crucial not only from an economic standpoint but also from a geopolitical and geoeconomic perspective, as they are expected to be the backbone of the global economy (Castro et al., 2019; Xuetong, 2020). According to Kim, Lee, and Kwak (2020), China has successfully led the development and application of disruptive technologies, representing a third of all 5G-related patent applications worldwide. Huawei leads the number of 5G patents with 15% of the total (Figure 21), and ZTE with over 11%, while Qualcomm, with over 8% of the total, positions itself as the leading US company in this field.

Figure 20. Human capital Index
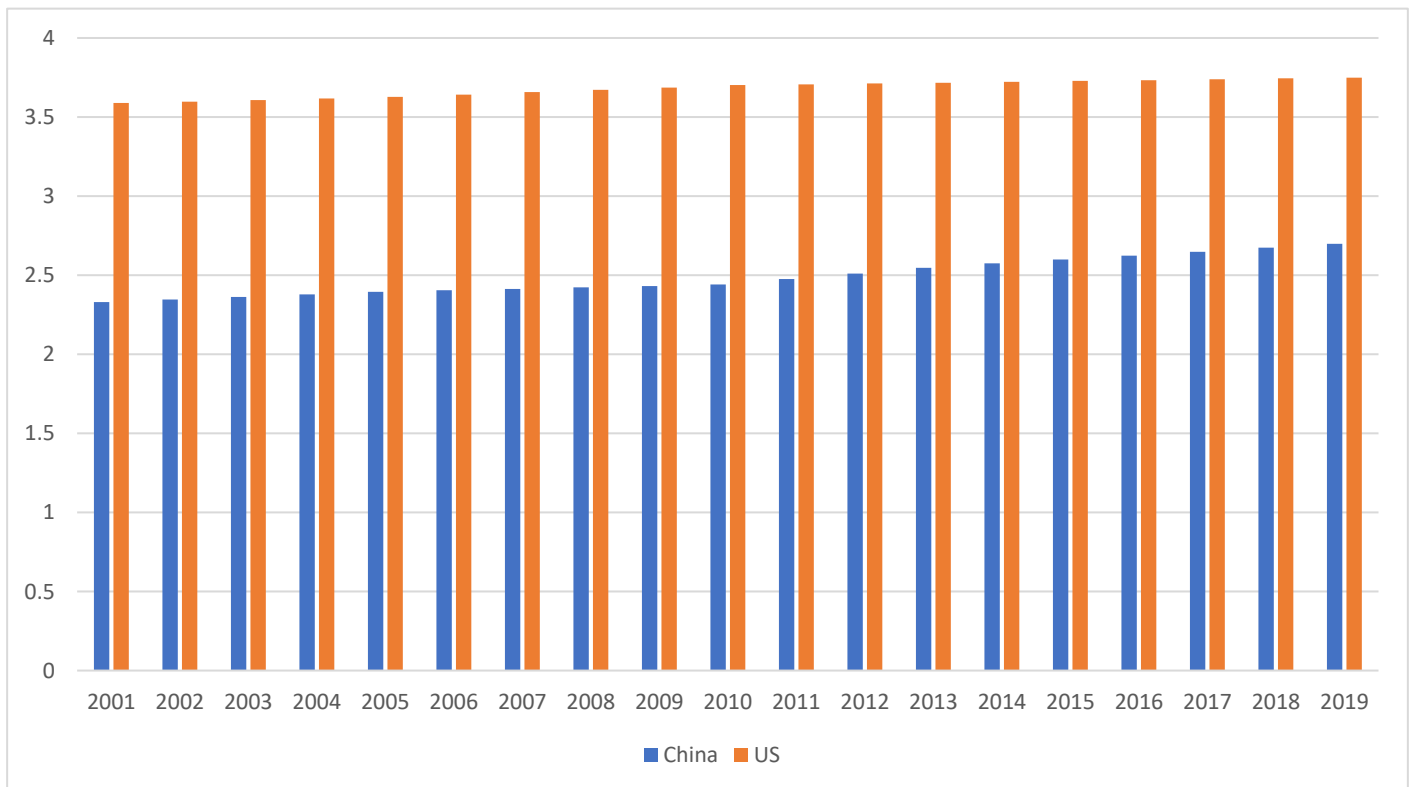
Source: Feenstra et al. (2023).

Furthermore, China has made significant strides in developing standards and norms for technology, contributing 33.96% of them in 2022, compared to the 15.89% from the US, according to data from IPlytics (IPlytics, 2022). Among the top 30 companies contributing to standards development, Huawei leads with the highest number of technical contributions submitted to 3GPP, accumulating 24,452 in 2022. The leading US company, Qualcomm, ranks fourth with 8,194 contributions. In response to this growing competition, the US has targeted Chinese companies like Huawei and ZTE, advocating their exclusion from crucial markets among its allies (Xuetong, 2020). Although numerous countries in Europe, Africa, the Middle East, and the Americas have allowed the use of Huawei's 5G equipment in constructing 5G infrastructure, the company has faced substantial operational challenges (Feng et al., 2019; Kim et al., 2020). In 2019, Huawei emerged as the world leader in smartphone sales, surpassing Apple with a domestic market share of 29%. However, due to the imposed restrictions over the following two years, its market share in China plummeted to a mere 7% (Statista, 2023). In contrast, Apple's market share in China increased from 9% to 17%. Despite ranking second in global smartphone sales in 2019, Huawei slid to tenth place in 2022. It is important to note that, at its peak, Huawei held a 20% global market share in smartphone sales (Statista, 2023).

Chinese companies' leadership in the global market is significant, as it will allow them to obtain significant benefits through the royalties derived from their 5G patents (Kim et al., 2020). This dominance in the field of 5G patents has far-reaching implications, as this technology is expected to be the central axis of the next industrial revolution. In addition, 5G patents will not only have applications in the telecommunications field. However, they will also play an essential role in developing smart cities and factories, autonomous and connected vehicles, and implementing

solutions for smart homes (Kim et al., 2020). Therefore, control and ownership of these patents give Chinese companies an advantageous position to lead and benefit from the evolution of industry and infrastructure in various sectors.

Figure 21: 5G patent holders.
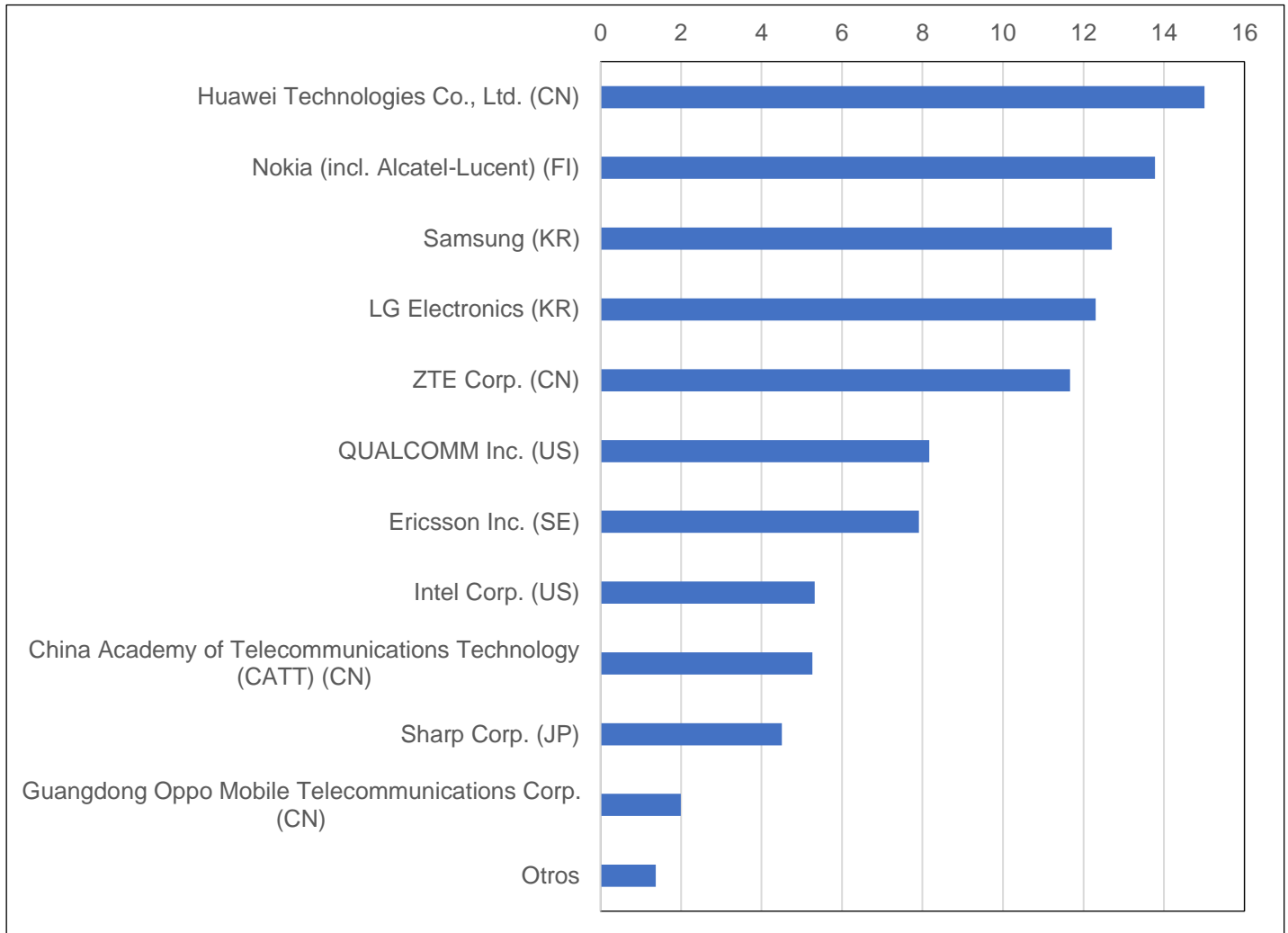
Source: Kim et al. (2020)

We are now focusing on AI development. The US is the undisputed leader in creating new machine learning systems, fundamental in generative AI. Companies such as OpenAI, Google, Meta, and Microsoft are at the forefront, developing systems such as GPT-4 (The Economist, 2023). This position reflects the US's strength in technological

innovation and its ability to lead in developing emerging technologies.

In AI research, China leads the way, surpassing the US in the proportion of highly cited AI papers. 26% of publications at AI conferences, and 9 of the top 10 institutions in AI publications are Chinese (The Economist, 2023). This leadership demonstrates China's strong commitment to academic research and its ability to contribute significantly to the global body of knowledge in AI.

However, the US is still the leader in terms of hardware development. Nevertheless, China is gradually closing the gap in fields such as supercomputer manufacturing and semiconductor development for artificial intelligence (Castro et al., 2021). This not only highlights the enduring strength of the US in the technology sector and shows China's growing capabilities to create and innovate cutting-edge technologies.

Despite these advances, China still faces significant weaknesses, especially in developing and producing AI chips, a situation that the US blockade has exacerbated. More than 50% of Chinese AI models rely on Nvidia, a US company, for processing. Although SMIC, China's leading semiconductor company, has progressed, it still lags behind its international competitors (The Economist, 2023).

Therefore, in the race for AI hegemony, the US maintains an advantage, especially in terms of hardware development and the creation of machine learning systems. However, China is making great strides, especially in AI research, and is working to close the gap in hardware development (Castro et al., 2021).

In terms of semiconductors, China tried to promote its technological autonomy, which has accelerated because of the shortage of components during the COVID-19 crisis and the US blockade on China's access to machines and intermediate inputs for chip manufacturing. The chip value chain is a complex process involving multiple stages and companies worldwide. Five main types of manufacturers can be identified in this process

(Kearney, 2021; Feás, 2023).

Basic developers focus on the early stages of chip design, with companies such as Cadence, Synopsis, CEVA, Lattice, Mentor Graphics, and Arm. At this stage, the US dominates with 95% of the value added (Kearney, 2021; Feás, 2023). On the other hand, advanced fabless developers are responsible for complex or specialized designs without producing the chips themselves. Some examples are Qualcomm, Nvidia, AMD, Xilinx, Marvell, MediaTek, and HiSilicon (from Huawei). Currently, China represents 5% compared to the US' 47%.

In terms of production, pure or foundry manufacturers such as TSMC, UMC, Global Foundries, and SMIC are responsible for producing chips for other companies under contract. In this case, the US accounts for 33% compared to China's 7%. These foundries use advanced machinery (the US accounts for 44% compared to less than 4% of China) and materials (19% compared to 5%, respectively) provided by companies such as Applied Materials, Lam Research, KLA, ASML, Tokyo Electron, Nikon, Canon Tokki, Shin-Etsu, Sumco, JSR, and Tokyo Onika.

Assembly, testing, and packaging (ATP) companies, such as ASE Technology, Powertech, JCET, UTAC, and Amkor, play an essential role in the final phase of the production process, ensuring that the chips are ready for distribution and use. In this case, China accounts for 14% compared to the US' 28%.

Finally, integrated device manufacturers (IDM) encompass all the functions mentioned above within the same business group. It is worth noting that some of these companies also carry out foundry tasks for other companies, further expanding their participation in the chip value chain. In this case, the US also leads the rankings with companies like Intel or Texas Instruments. The US accounts for 39% of the value added in the entire chain, compared to China's 6%.

On the other hand, within the technology sector, energy transition deserves special attention. China's efforts to promote renewable energy have positioned the country as a critical player in the GVC of the sector, being the country that invested the most money in renewable energies in 2022, as shown in Figure 23. Specifically, the investments in renewable energy in China have been directed toward reducing the country's dependence on fossil fuels and strengthening the country's position in producing renewable energy technologies, such as solar panels and wind turbines. This is significant, given that the production of renewable energy technologies is highly concentrated, with a few countries, such as China, dominating the production and export of these technologies. Therefore, the energy issue is also linked to the production sector in terms of production capacity and the competitiveness of countries in the global economy.

In addition to its leadership in renewable energy production, China also plays a dominant role in various areas of the global supply chain for renewable energy, consolidating its position as the world's leading manufacturer of solar panels, responsible for over half of global production. Specifically, China is leading the world in solar and wind power generation (Figure 24 y 25), accounting for more than one-third of the world's solar capacity and almost one-third of the world's wind power capacity. The country is also making progress in developing electric vehicles, with companies such as BYD, Nio, and Xpeng Motors being some of the industry's most innovative and dynamic players. The manufacturing of lithium-ion batteries is also an essential industry in the country, with China leading in the provision of batteries for electric vehicles and energy storage systems (Statista, 2023).

Figure 23. Top 10 countries for energy transition investment, 2022 (billions of dollars).
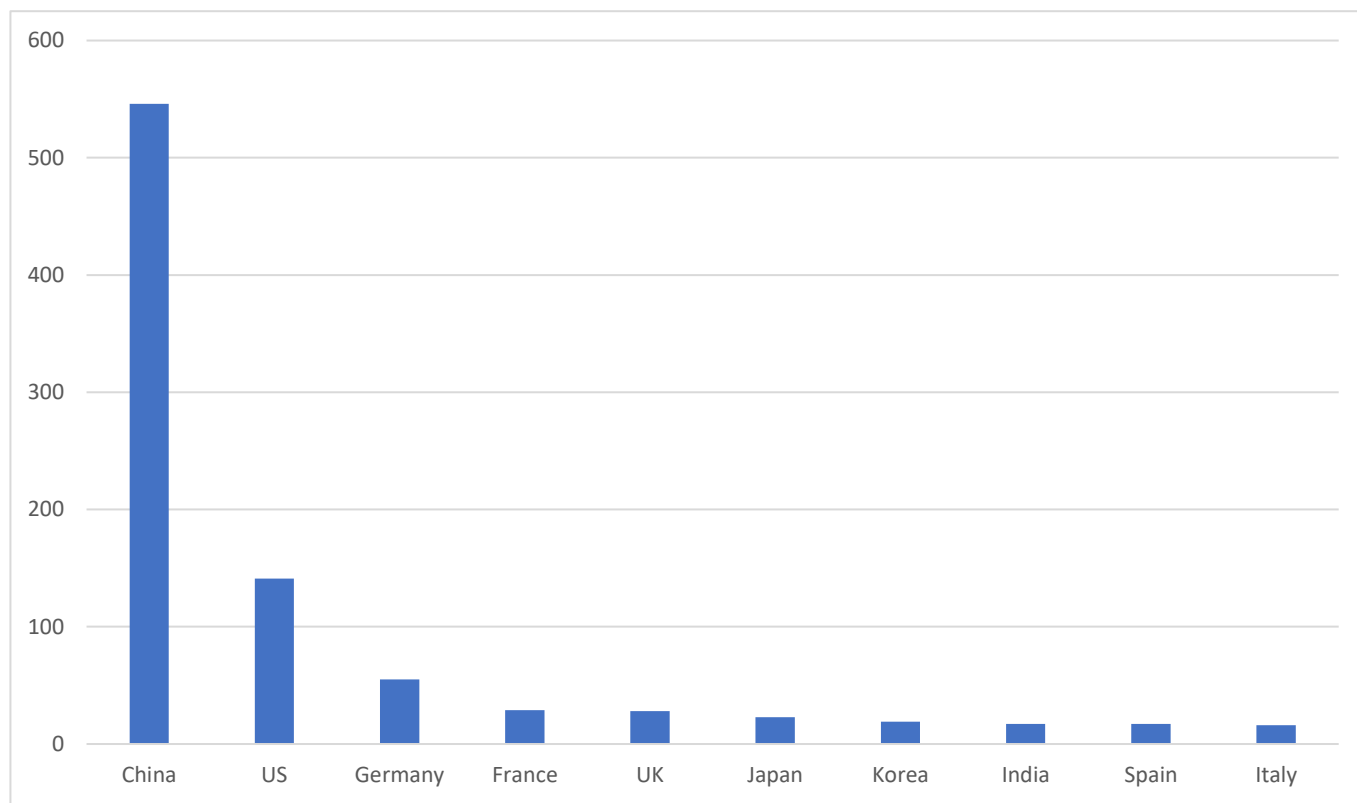
Furthermore, China is a critical provider of electronic components for producing solar panels and battery systems. These components include solar cells, inverters, and charge controllers. Despite not being the leader in wind turbine manufacturing, China is a prominent manufacturer and supplier of such equipment (Statista, 2023).

In terms of added renewable energy capacity, China has led the global market in the last decade, ranking first in the 2012-2021 period for both wind and solar energy (Figures 24 and 25). This shows the country's commitment to advancing clean energy technologies and its strategic position in the global supply chain for renewable energy.

The solar energy value chain encompasses several processes and stages, from obtaining raw materials to producing and using solar panels. Raw materials used in solar panel production include silicon, tin, silver, and copper. According to Bloomberg NEF

data (2022), mining of these materials occurs in various countries such as China, Australia, Russia, and South Africa. These raw materials are processed into intermediate materials, such as silicon powder and silicon wafers used in producing solar panels. China leads this process, followed by Asian countries such as South Korea, Taiwan, and Japan (BloombergNEF, 2022).

Figure 24. Top 10 markets for wind capacity additions, 2012-2021, Gigawatts (GW).
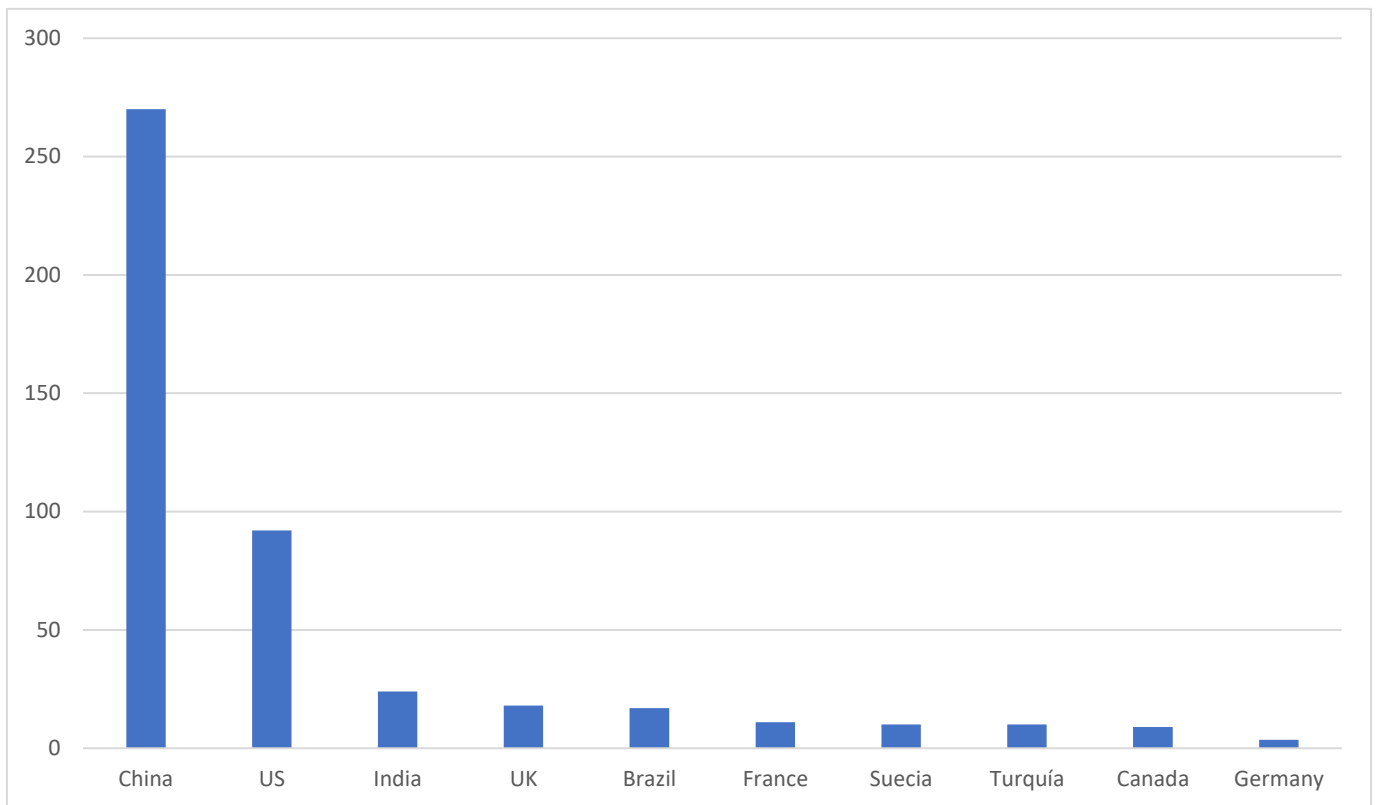
Source: BloombergNEF (2022)

Solar cells, key components of solar panels, are manufactured from intermediate materials. China is the leading producer of solar cells, followed by Taiwan, South Korea, Malaysia, and other Asian countries. The production of solar panels is carried out using solar cells and other components, with China leading this sector, followed by Taiwan, South Korea, Malaysia, and other Asian countries. Solar panels are installed in solar projects and used to generate energy. Leading countries in installing and using solar

energy include China, the US, Germany, Japan, and other European and Asian countries (BloombergNEF, 2022).

Figure 25. Top 10 markets for solar capacity additions, 2012-2021 GW
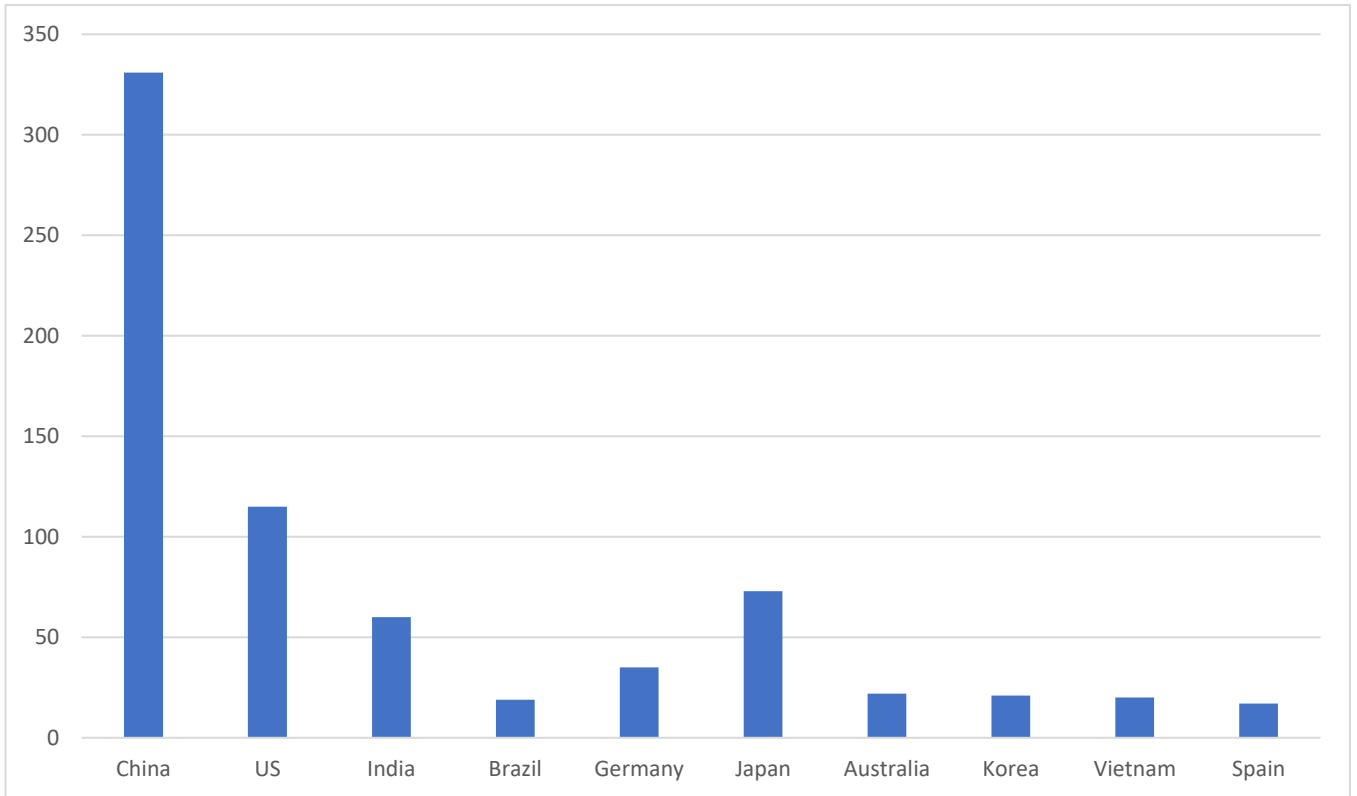
Source BloombergNEF

In summary, China's KTI industry growth signifies a notable shift in the balance of technological power. Specifically, China has surpassed the US in added-value production within the manufacturing sector of KTI industries. Nevertheless, the US retains strong leadership in KTI services and R&D-intensive industries. This suggests that although high-tech manufacturing is moving toward Asia, the US remains a leader in innovation and technologically advanced services.

Secondly, the growth of Chinese investment in R&D, up to 2% of its GDP, is a clear indicator of its commitment to technological development. However, the US continues to lead the way in this regard, with an investment of close to 3.5% of its GDP

in R&D. This reflects the high priority both countries assign to R&D to stimulate innovation and competitiveness.

Regarding intellectual property, China's rapid increase in patent acquisition indicates its growing technological capacity. However, the concentration of these patents domestically and the challenges of internationalization suggest that China still has significant hurdles to overcome in terms of patent quality and the adoption of its technologies and standards abroad. Nevertheless, we could add the data on trademarks and industrial designs seen in the previous section. In that case, the apparent increase in all three indicators suggests that China is starting to get results in its commitment to internationalize its technology and scale up in the GVC, getting technologically closer to the US.

Lastly, the technological rivalry between China and the US, centered on key technologies of the Fourth Industrial Revolution, like 5G and artificial intelligence, underscores the high economic, geopolitical, and geoeconomic stakes. China has had notable success in implementing disruptive technologies and leads in developing technical standards in 5G, which could afford it a competitive edge in the future. However, geopolitical tensions and restrictions imposed on Chinese companies like Huawei and ZTE present significant challenges. At this point, controlling these patents could provide Chinese companies with a long-term strategic advantage and could affect the power balance in the global digital economy.

As for AI development, we observe a divided leadership. The US dominates in creating new machine learning systems, reflecting strength in innovation and emerging technology development. However, China leads in AI research, showcasing its commitment to academic research and ability to contribute significantly to global AI knowledge. In terms of hardware development, China still has significant challenges to

overcome, especially in developing and producing AI chips. This crucial weakness may limit China's ability to catch up with and surpass the US regarding large-scale AI implementation and application.

The COVID-19 crisis and sanctions imposed by the US have exposed China's reliance on foreign semiconductor components, intensifying its efforts to promote technological autonomy. However, the chip value chain is a complex process requiring significant coordination and competition at multiple stages. The US still dominates most of these stages, although China is making strides in specific sectors, such as assembly, testing, and packaging.

Regarding the energy transition, China is leading in investment in renewable energy and the production of associated technologies. This is significant as the production of these technologies is highly concentrated, with few countries dominating production and export.

China's ascent in the global technology scene is not fortuitous but the outcome of a well-defined and implemented industrial policy strategy, displayed by initiatives like MIC2025 (See Chapter 3). This industrial policy, which is both protectionist and promotional, enables China to sustain and propel strategic industries over lengthy periods, even if they initially operate at a loss.

Through a blend of state investment in R&D, protection and support for domestic enterprises, and occasionally through foreign technology acquisition, China has rapidly ascended in critical sectors such as 5G telecommunications and renewable energies. China's strategy of fostering select industries has enabled companies like Huawei and ZTE to amass a significant portion of global 5G patents.

However, this selective approach also has its limitations. Despite significant strides in chosen sectors, China must translate this success into widespread technological

dominance. Firstly, while China has substantially improved its human capital capacity, it still lags behind the US in terms of educational attainment and years of schooling, critical indicators of a nation's innovation potential.

Furthermore, although China has significantly increased its R&D expenditure in recent years, it still trails the US in terms of R&D spending as a percentage of GDP. This fact is pertinent because the magnitude of R&D investment is a critical indicator of a country's potential to generate innovations that can have broad-based applications across multiple sectors of the economy.

Thus, while China's industrial policy strategy has enabled specific Chinese industries and companies to scale globally rapidly, China's capacity to surpass the US regarding broad-based technological dominance is constrained by various factors. These include gaps in human capital and R&D expenditure and challenges in enhancing patent quality and promoting international adoption of Chinese technologies.

Additionally, the Fourth Industrial Revolution provides a unique opportunity for countries to establish leadership positions in emerging, strategic technologies. In this era of technological disruption, those who innovate and rapidly adopt new technologies may gain a substantial competitive advantage, further reinforced through economies of scale, network standards, and learning effects.

Specifically, economies of scale refer to the cost-effectiveness achieved as production increases. The larger the output, the lower the unit cost of production. Network standards, on the other hand, refer to the concept that the value of a product or service increases as more people use it. In the case of emerging technologies such as 5G and artificial intelligence, those countries or companies that establish the initial standard can often gain a substantial advantage, as other companies must adopt this standard to maintain compatibility.

Indeed, as China continues to invest heavily in R&D and deploy emerging technologies like 5G and artificial intelligence, it is positioning itself to take the lead in the Fourth Industrial Revolution. However, while China has shown an impressive ability to scale in selected technologies rapidly, it still needs to translate this success into broad-based technological dominance.

China's strategy of fostering selected industries has allowed companies like Huawei and ZTE to acquire a significant share of global 5G patents. However, while this early position may provide a substantial advantage, long-term success will require more than just setting standards. It will demand the ability to continually innovate and adapt to a rapidly evolving technological landscape, areas in which the US still holds an edge.

This shift in technological power balance carries significant implications for global productivity and technological hegemony. The emergence of China as a key player in high-tech manufacturing could alter the structure of the global economy, with possible implications for trade norms, job distribution, and technological innovation.

In conclusion, while China is making leaps and bounds in various technology areas, such as energy or 5G, it still faces significant challenges, particularly in hardware development and the production of advanced chips. In particular, leadership in 5G or energy transition technologies could offer China a long-term strategic advantage and alter the balance of power in the global economy. This analysis of technological material capabilities will be expanded in Chapter 5 through the application of the second and third phases of the methodology (static-structural and dynamic-structural).

4.2.3. Commercial hegemony

The analysis of commercial hegemony starts with merchandise data (total and by region)

and services data. Figures 26, 27, and 28 reveal various facets of the dynamic between China and the US, the contemporary world's commercial giants. As Figure 26 indicates, China has become the world's largest goods exporter, a position that substantiates its formidable productive capacity and competitiveness in global markets. Conversely, the US is the leading importer, signaling its vast consumer market and demand for foreign goods.

Regional dynamics also provide interesting insights, as illustrated in Figure 27. China's export dominance is discernible across all regions except the American continent, where the US retains its stronghold. Such regional variation might reflect both historical trade relations and geopolitical influences.

Figure 26. World merchandise trade in 2022 (billions of dollars)
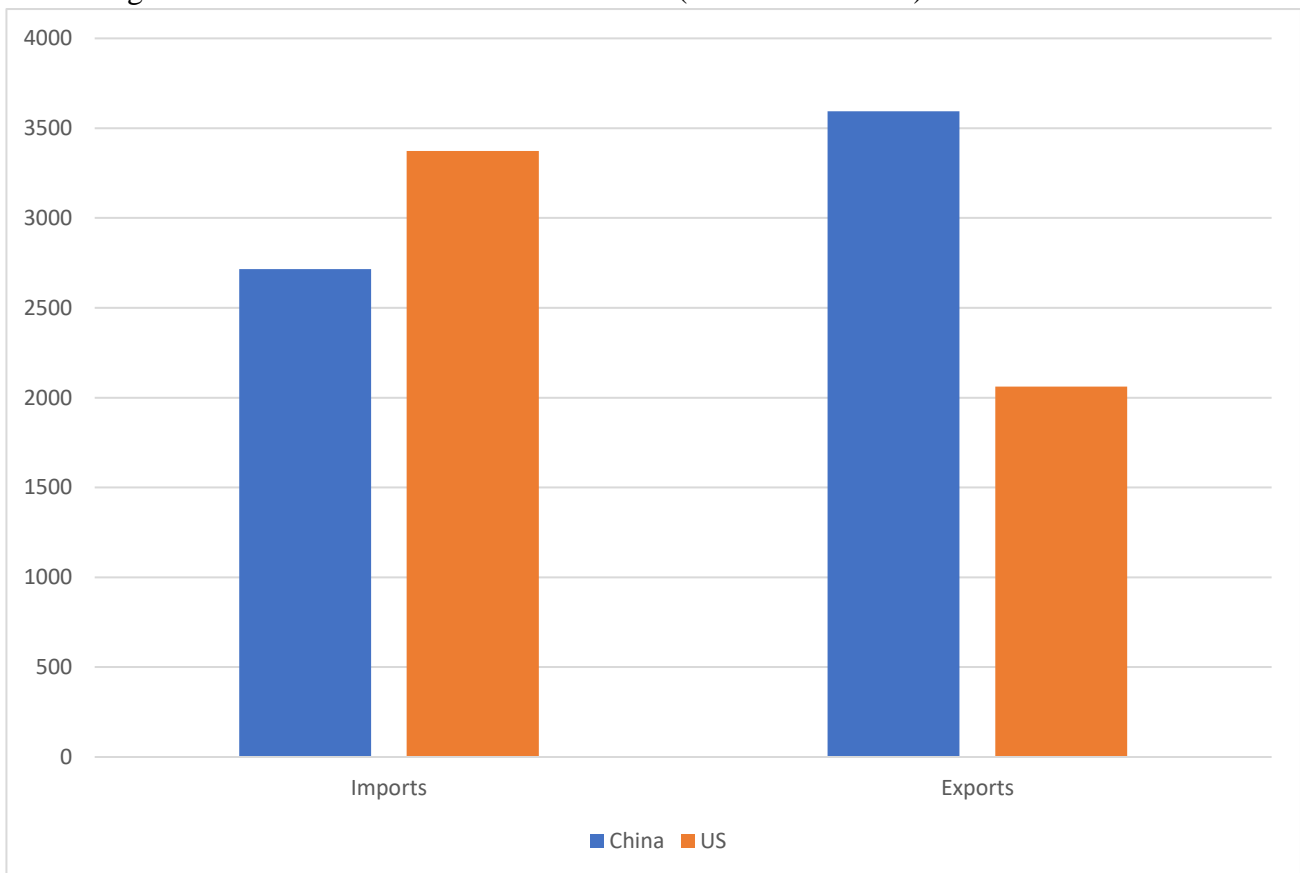
Source: Comtrade (2023)

Figure 27. World merchandise trade by region in 2022 (billions of dollars)
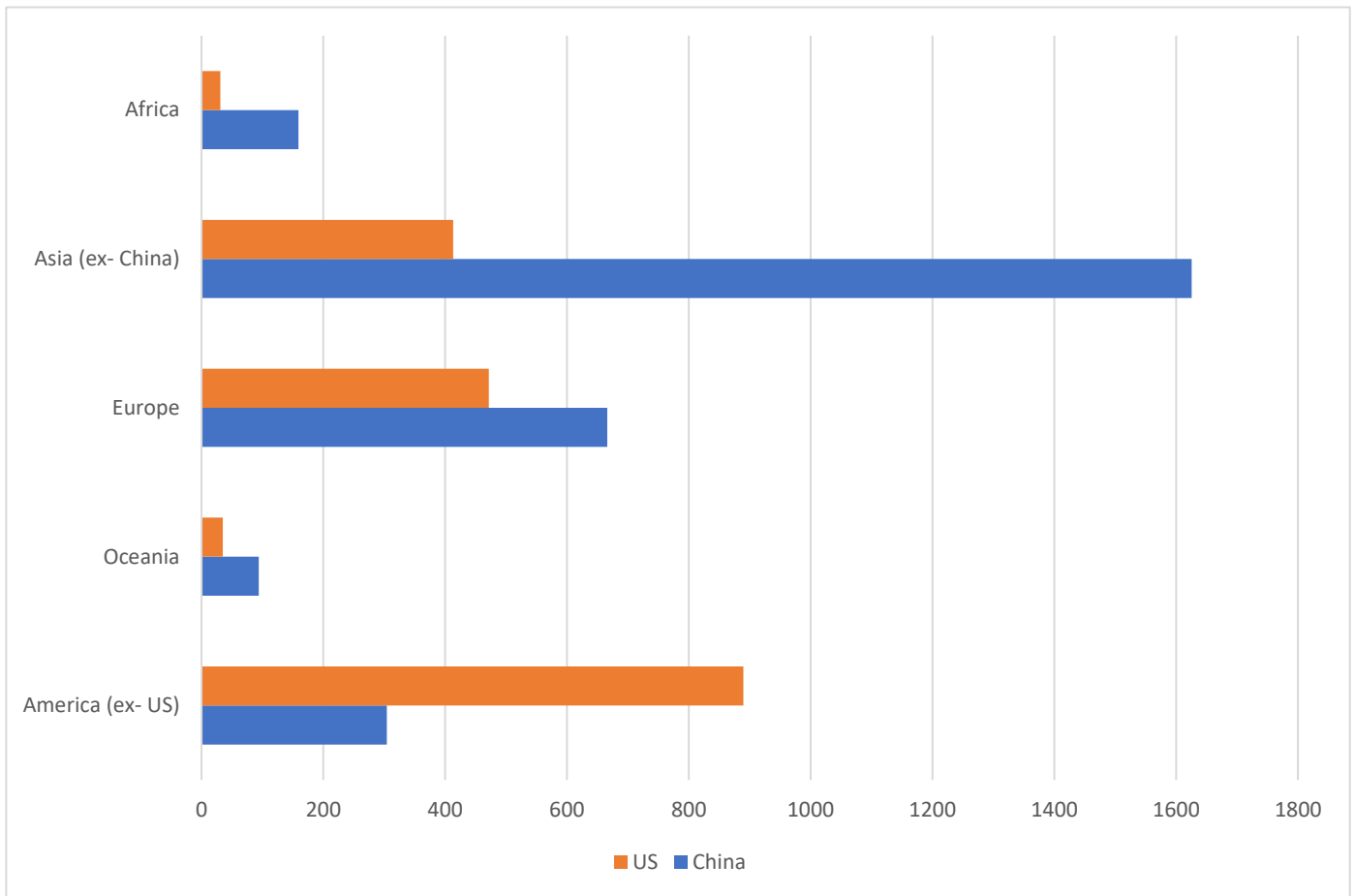
However, in the services sector, the narrative shifts. Figure 28 illustrates that the US leads in services imports and exports, indicating its strength in the service economy and its ability to generate and attract high-value-added services.

Our analysis also incorporates a longitudinal perspective to assess the evolution of China and the US trade relations with the rest of the world. Since 2001, the year when China joined the WTO, there has been a significant shift in the global trade landscape. By 2018, more than two-thirds of the countries (128 out of 190) traded more with China than with the US, reflecting China's exponential growth and burgeoning influence in the global economy.

Figure 28. World services trade in 2021 (billions of dollars)
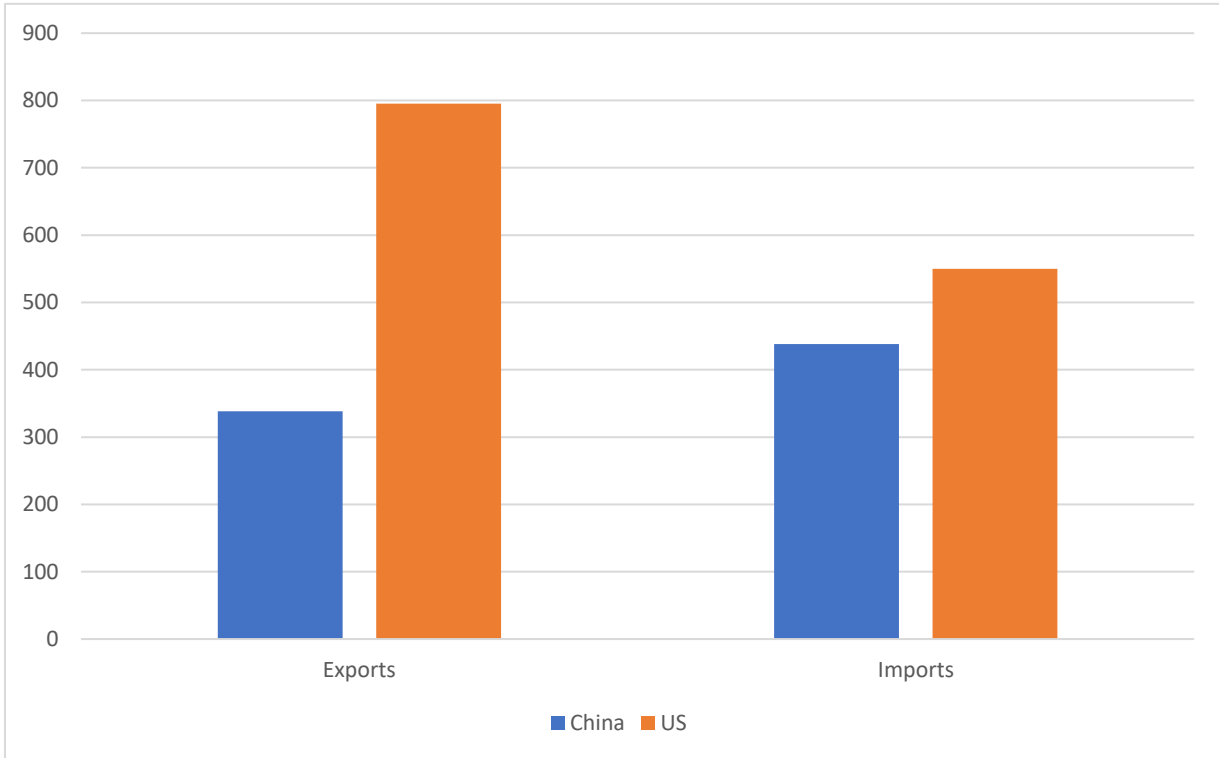
Source: Comtrade (2023)

We come at a more nuanced view by incorporating value-added analysis into our methodological tools. As Figure 29 demonstrates, even though China is the world's foremost goods and services exporter, the value-added of US exports considerably outstrips that of China. This finding can be attributed to each country's industrial structure, emphasis on innovation and intellectual property, and their place in global value chains.

The US has consistently grown its value-added exports, reflecting its leadership in the high-tech and services industry and its robust protection of intellectual property rights. In contrast, despite accelerated growth in its exports, China has had a lower value-added, reflecting its historical focus on low-cost manufactured goods production. However, China has been gradually redirecting its focus towards higher value-added industries, indicating an evolution in its trade strategies.

Therefore, despite its dominance in terms of trade volume, China's commercial

hegemony still has room to grow in terms of value-added. In this regard, the US remains

a powerful contender, boasting a strong services economy and high value-added exports.

Figure 29. Trade in Value Added: Origin of value added in gross exports (US Dollar, Millions)
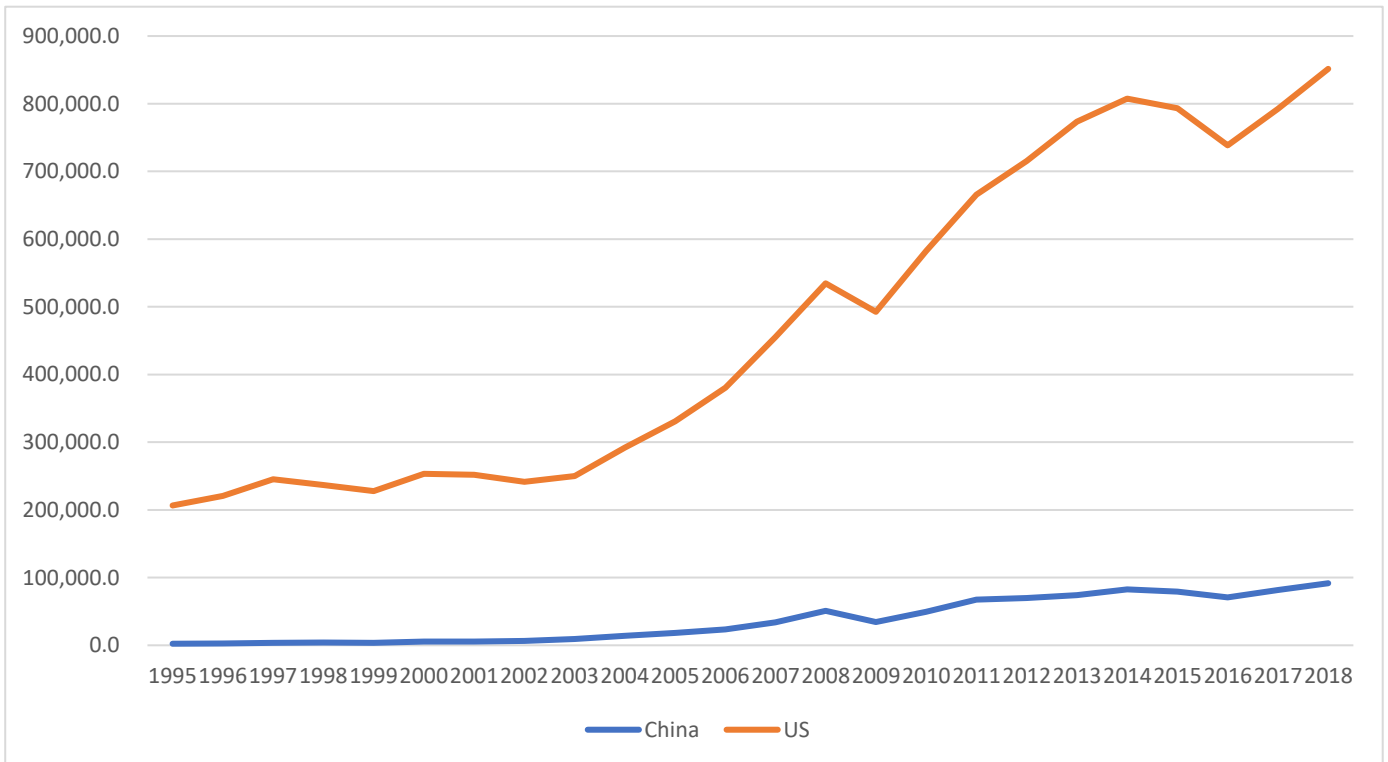
Source: OCDE (2023)

To summarize, China has ascended to considerable global prominence, evidenced

by its status as the world's preeminent exporter. This firmly establishes China as a

formidable pillar in the global trading landscape. However, the realm of trade is

multidimensional. While China maintains dominance in the goods export sector, the US

is the largest importer and asserts itself as the principal actor in service imports and

exports.

Our examination of the past few decades presents a marked shift in global trade

dynamics. By 2018, a vast majority—two-thirds—of countries reported higher trade

volumes with China than the US., a significant change from the landscape in 2001 when

80% of countries conducted more substantial trade with the US. This trend underlines China's expanded influence in global trade and its successful engagement with a broad network of trading partners.

However, the picture becomes more nuanced when the analysis turns to the value-added of exports. Despite China's dominant status as the world's premier exporter of goods, the value added from the US exports eclipses that of China. It suggests that, while China handles a more significant trade volume, the US may derive more value from its exports. It could show the US' competitive innovation advantage and technological superiority.

Nevertheless, one must pay attention to the dynamic nature of China's trade strategy. China's recent focus on higher value-added industries and its amplified investment in research and development signals a paradigm shift in its trade policy and strategy. Such strategic maneuvers indicate China's commitment to closing the gap in value-added exports with the US.

In conclusion, while China has expanded its trade volumes and continues to build its network of trade partners, the US holds a vital position in the high value-added exports sector and maintains its leadership in the services trade. However, China's strategic tilt towards increasing the value-added dimension in its exports might instigate a future shift in the balance of trade hegemony.

4.2.4. Financial hegemony

In the analysis of the financial capabilities, we first examined the size of the financial markets of each country (Figure 30). According to Statista (2023), the largest stock markets in the world in January 2022, by share of the total value of the global equity market, are the US with 59.9%, Japan with 6.2%, the United Kingdom with 3.9%, China

with 3.6%, and France with 2.8%.

Figure 30. Market share of total world equity market value in 2022.
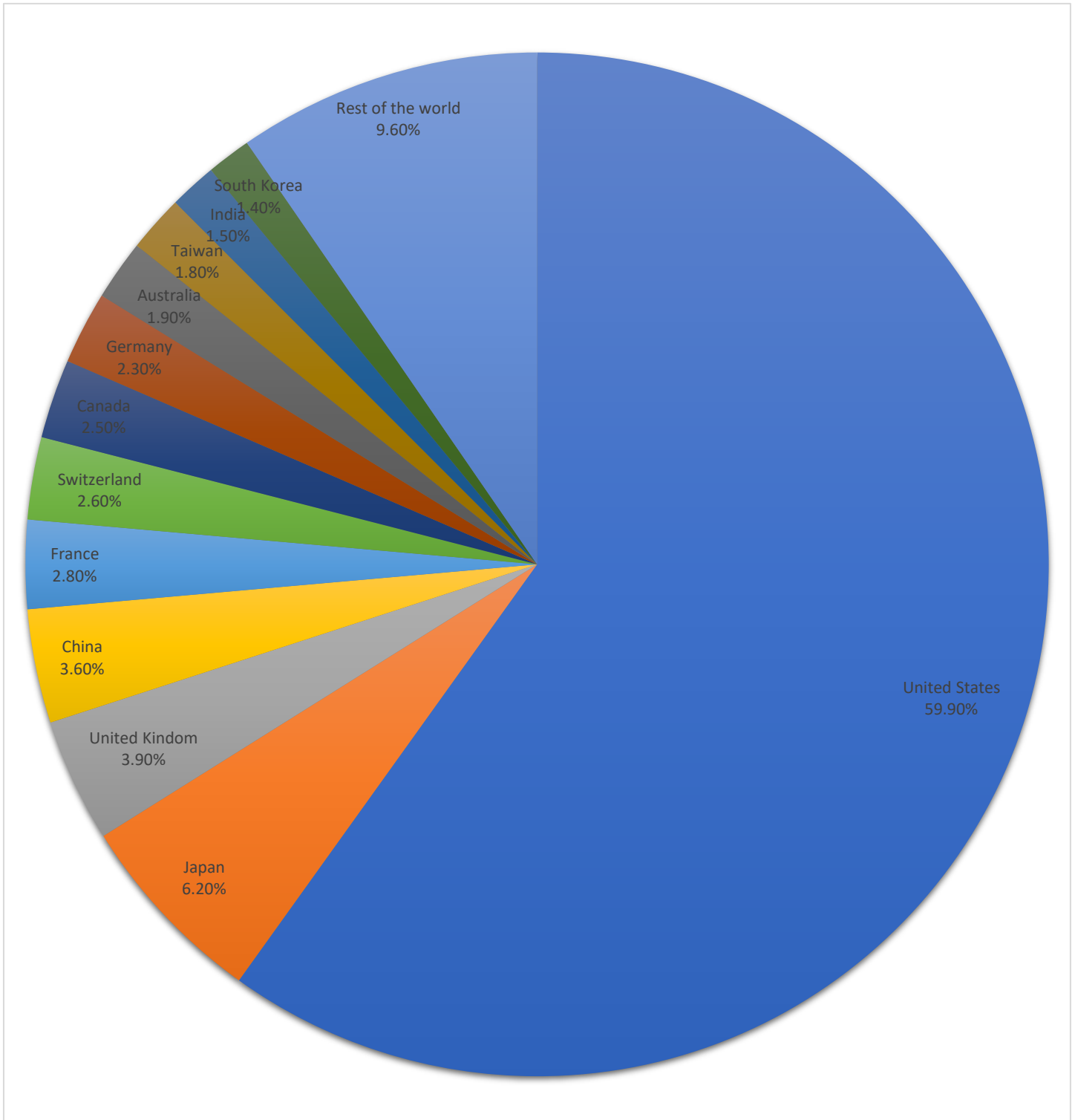
Source: Statista (2023)

Next, we analyzed the composition and size of each country's bond market, including sovereign and agency bonds, supranational bonds, and corporate bonds, to assess the weight of each country in the global financial system. The global size of bond markets in circulation, in terms of USD notional equivalent, is approximately 128.3 trillion USD, with 87.5 trillion USD in supranational, sovereign, and agency (SSA) bonds (68%) and 40.9 trillion USD in corporate bonds (32%) (International Capital Market Association, 2023). The SSA bond markets are dominated by the US, China, and Japan, representing 62% of the global market, while the global corporate bond markets are led by the US and China, which account for 45% of the market.

Regarding the use of currencies, the proportion of the US dollar in global foreign exchange reserves has steadily declined over the past two decades. However, it remains the dominant currency in central bank foreign exchange reserve portfolios (Figure 31). The use of traditional reserve currencies, such as the euro, yen, and pound sterling, has not grown significantly, while other alternative currencies have slightly increased, such as the Chinese yuan, which represents only 2.7% of global foreign exchange reserves.

Figure 31. World Currency Composition of Official Foreign Exchange Reserves.
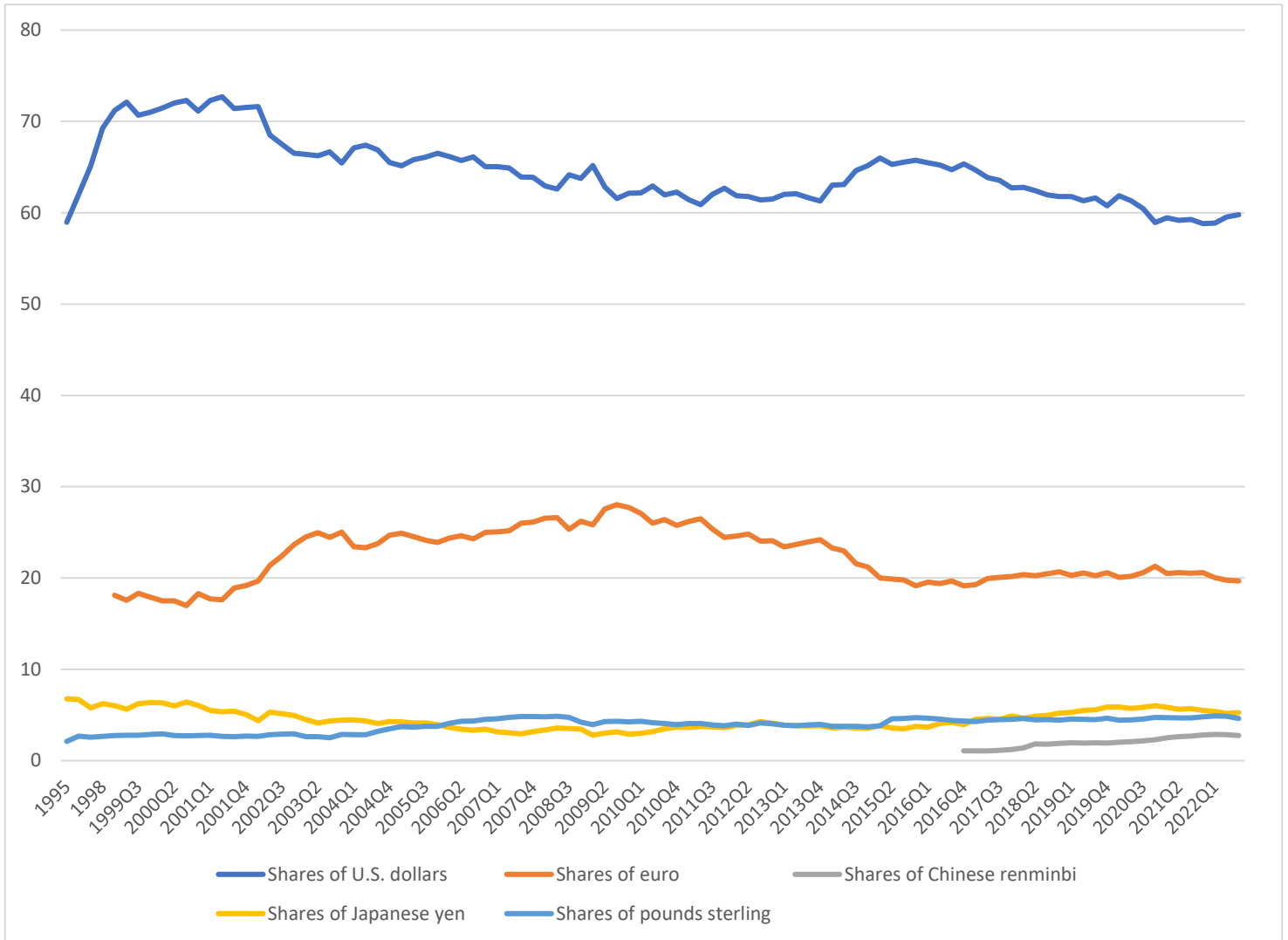
Source: IMF (2023)

Related to their use as a payment medium (Figure 32), the US dollar is used in 42% of transactions, the euro in 35%, the pound sterling in 6.54%, the Japanese yen in 2.88%, and the Chinese yuan in 2.44%. Regarding the currency composition of global foreign exchange transactions (Figure 33), the US dollar is involved in nearly 90% (over 200%) of foreign exchange transactions as it is vital in currency triangulation. Although the Chinese yuan's weight is not significant (7%), it has grown considerably, as, in 2010, it only represented 1%.

Figure 32. Share of global payments currency
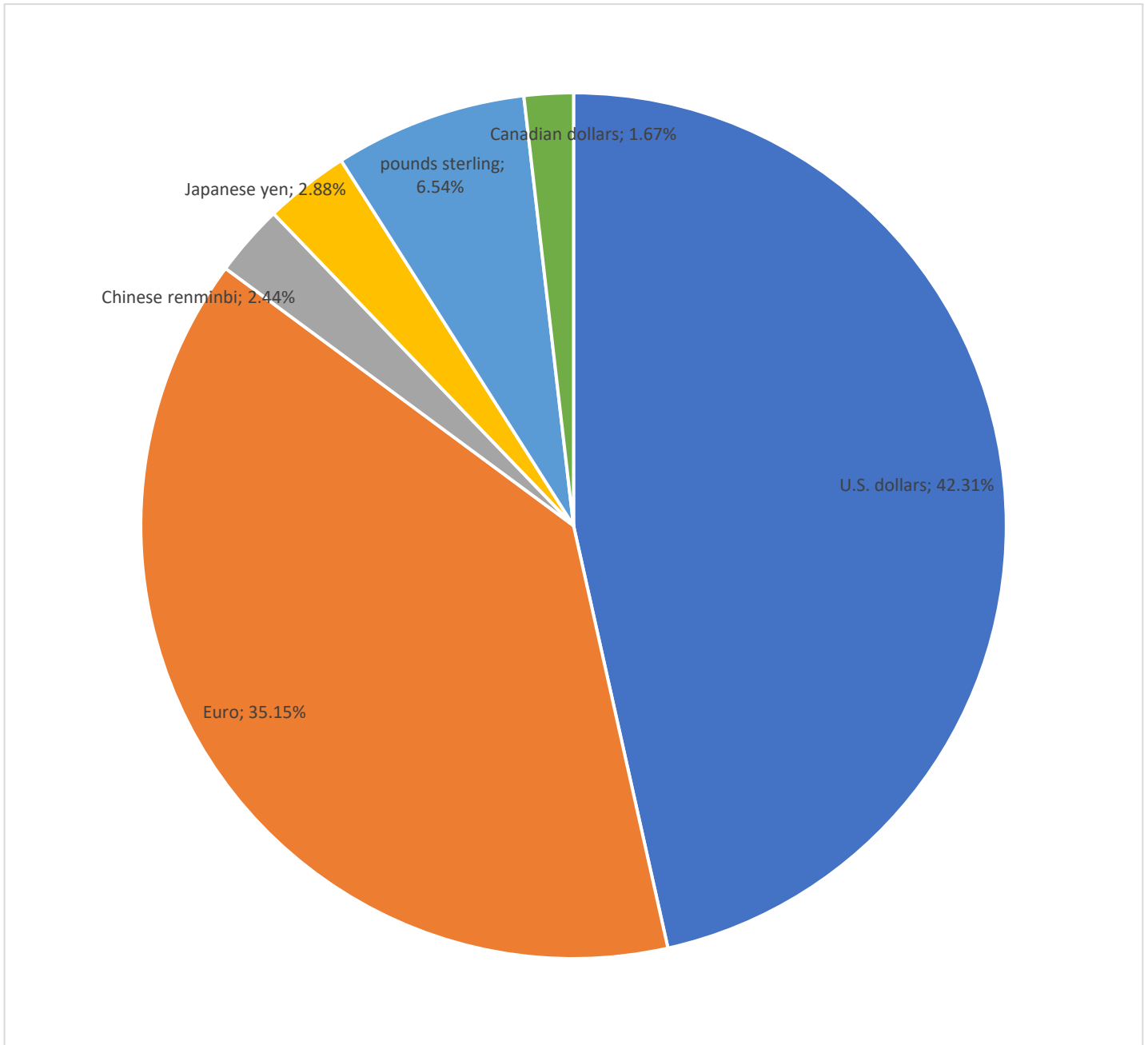
Source: SWIFT (2023)

Figure 33. Percentage of foreign exchange transactions per currency as part of a transaction (over 200%).
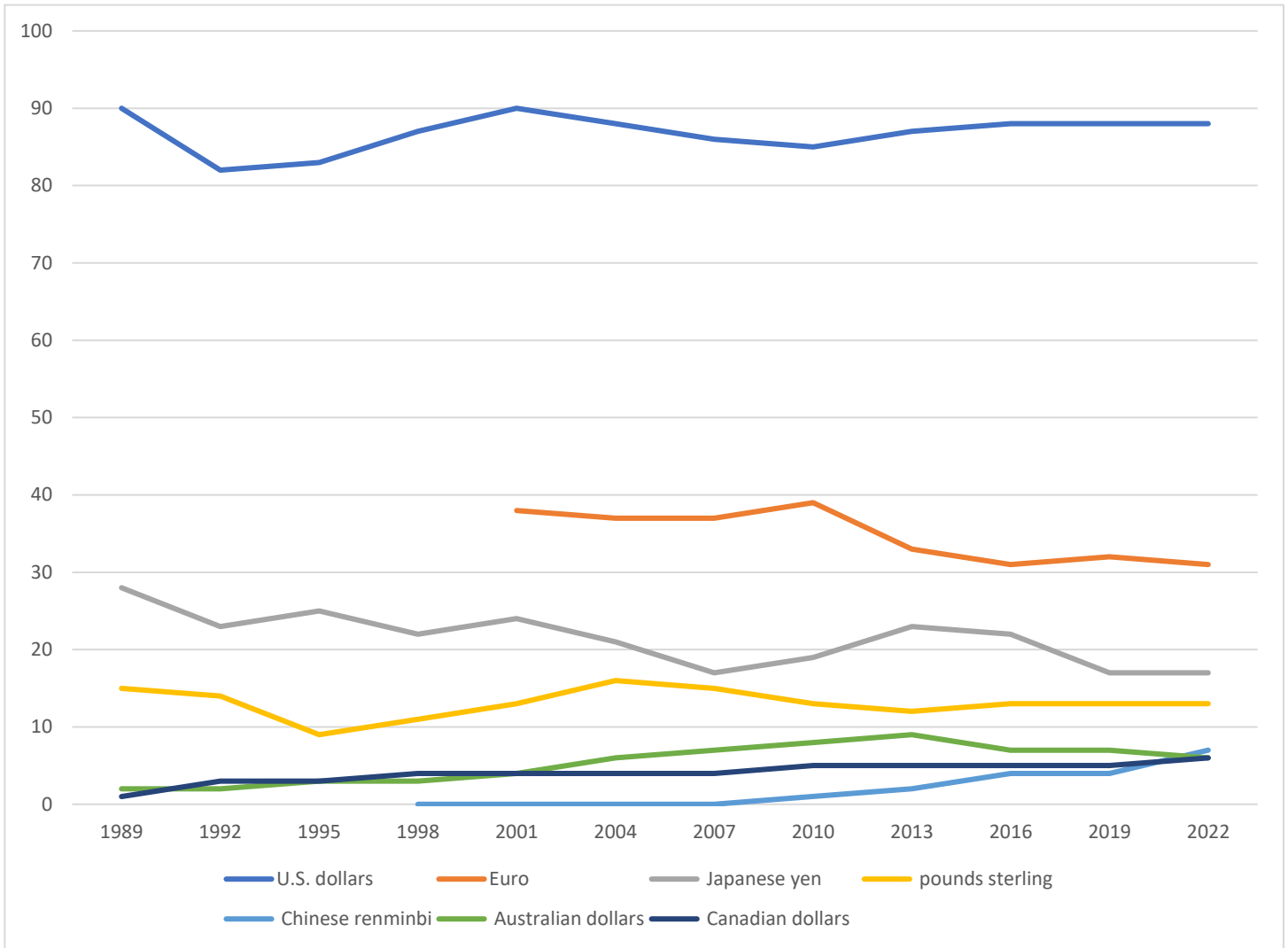
Source: BIS (2023)

If we look at the current account balance data (Figure 34), China has consistently maintained a current account surplus from 2001 to 2021. This surplus reflects China's export-oriented growth model, which has leveraged its comparative advantage in labor-intensive manufacturing to become the world's factory (see Chapter 3). China's significant surplus indicates a high savings rate and reliance on external demand for economic growth.

In contrast, the US has run a current account deficit during the same period. This deficit points towards the US' consumption-oriented growth model. High imports indicate

a strong demand for foreign goods and services, often fueled by high consumer spending. The US deficit also reflects its position as the world's primary consumer market and the role of the US dollar as the primary global reserve currency.

Almost a mirror image exists between China's current account surplus and the US.'s current account deficit. This symmetry can be explained by the global recycling of China's surplus. China, in essence, has recycled its surplus by buying US debt securities, especially US Treasury bonds. This process has allowed the US. to sustain its high consumption levels and the current account deficit.

China's purchase of US bonds accomplishes several objectives. It keeps the value of the Chinese yuan low compared to the US dollar, helping Chinese exports stay competitive. It also provides China with a relatively safe and liquid investment for its surplus. On the other hand, the US benefits by securing a steady source of demand for its government debt, helping to finance its public spending, and keeping interest rates low.

This symbiotic, albeit imbalanced, has underpinned the global economic order in the 21st century. However, sustainability could change China's shifts towards a more consumption-oriented growth model.

Figure 34. Current account balance (billions of dollars)
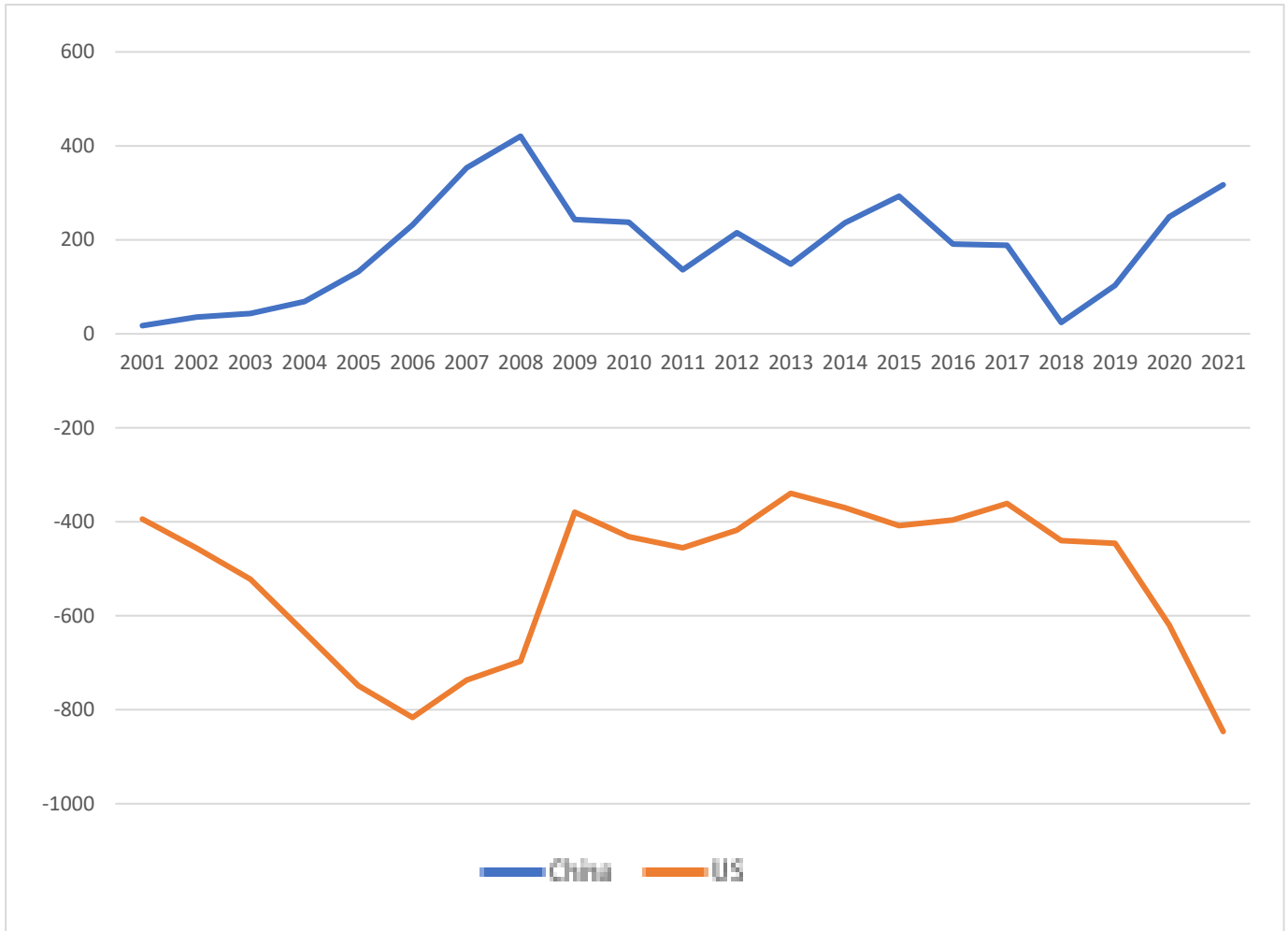
Source: World Bank (2023)

Based on the data analysis and results, it is evident that the US maintains a dominant position in the global financial system, with the dollar remaining the dominant currency of international trade and finance. Although China has made significant efforts to internationalize its currency and expand its financial capabilities, the yuan still has a long way to go before challenging the dollar's hegemony.

Overall, the data analysis and results suggest that the US maintains a significant advantage over China in terms of financial and monetary capabilities, and there are no indications that this will change soon. Therefore, the US is likely to continue to play a dominant role in the global financial system in the coming years.

4.2.5. Summary on the comparison of the material capabilities between China and the US

The four pillars of hegemony—productive, technological, commercial, and financial—provide a comprehensive view of the US and China's respective power related to their material capabilities. Both nations demonstrate strengths in different areas, highlighting the complexities of global hegemony.

In the analysis of productive hegemony, the changing dynamics of global productive power are highlighted as China increasingly challenges the long-term productive hegemony of the US. Although China has a lower GDP per capita and lower GDP in current terms, its rapid economic growth has caused it to overtake the US regarding purchasing power parity GDP and industrial weight (in value-added) globally. The same is true for the projection of Chinese trademarks and their industrial designs, which have recently surpassed the US. However, US companies continue to dominate in terms of their overall global strength, with higher total sales, profits, assets, and market value, reflecting the strength of US companies worldwide. Another critical aspect in this regard is productivity. China's productivity has improved in recent years but remains much lower than that of the US. This is another indicator that reflects the fact that the Chinese economy rivals the US economy much more in extensive capacity (in terms of size) than in intensive capacity (in terms of efficiency). This fact is particularly relevant since China has been trying for years to boost its technological development to increase productivity, so depending on the success of these policies, it may or may not be able to catch up with the US in this area.

On the other hand, the US continues to attract more FDI. Although China is close behind, the US is far superior in terms of FDI inflows, which implies a more significant

influence in the productive area of the rest of the world. Therefore, no clear evidence exists in any country's favor in the productive area. However, in general terms, the US is still ahead, especially in the most intensive aspects. Nevertheless, the trend favors China, which may dominate in extensive or size-related capabilities.

Technologically, both countries are frontrunners in various sectors. The US excels in AI and semiconductors, whereas China has advanced in 5G and energy transition technologies. Despite China's progress, the US retains the lead in R&D and human capital-crucial factors for innovation. Moreover, the US's supremacy in innovation rankings and patents filed abroad underscores its broader technological influence. In this line, although the US leads, China is managing to compete (AI, 5G) and even surpass the US by far (in new energy technology), which is critical during a technological transition. As Rikap & Lundvall (2021) point out, significant technological changes, such as the current one, represent a window for new powers to install their power and surpass the existing ones. China's dominance in certain cutting-edge technologies could give it a significant advantage in the struggle for hegemony. This fact explains the US reaction aimed at slowing down the technological rise of the Asian country through a blockade of critical technologies (Sullivan, 2022).

On the trade front, China's rise as the world's leading exporter makes it a key player in world trade. However, the US continues to exert considerable influence as the world's largest importer and a major player in services trade. There is a significant shift towards China in trade dynamics, with most countries reporting higher trade volumes with China than with the US. However, the US derives more economic value from its exports, indicating its competitive advantage in innovation and technological prowess. Despite the increase in trade volumes and China's vast trade network, the US maintains its position in high-value-added exports and services trade. This fact reflects factors

similar to those seen in productive and technological hegemony, as China stands out in extensive terms (exports of goods). However, when analyzed in intensive terms (value-added or high-value exports), the US has an advantage. This reinforces the fact of the US's greater productive and technological development, despite Chinese advances, and shows how China has a primordial role as a trading partner. China's role as a significant exporter is critical, as, in a context where interdependencies are transformed into a weapon or a tool of power, China can take advantage.

Finally, in the financial sector, the US continues to dominate, with the dollar as the primary currency of international trade and finance. China's efforts to internationalize the yuan are noteworthy but remain far from challenging the dollar's hegemony.

In conclusion, if we combine the four areas, we can see that China is a critical player in the world economy since, in some aspects, it is already the world's leading economy (from exports to the size of GDP in PPP, including the annual flow of trademarks and industrial designs in the world). This is already a change in the international economic order since variations in the economy or decisions taken by Beijing influence the rest of the world. In addition, China has managed to compete in developing key technologies, mainly 5G, and has far surpassed the US in technologies related to the energy transition. This fact is critical in the context of technological change such as the current one, as there are clear. In this sense, China is a formidable competitor of the US in the productive, technological, and commercial spheres, even surpassing the US nation in crucial areas such as value-added manufacturing, leadership as a first trading partner, and the spread of trademarks, as well as the development of critical technologies such as 5G and those linked to the energy transition. However, in the financial sphere, the US maintains its leadership position, underpinned by a leading financial system and the primacy of its currency in the global financial structure. These dynamics highlight the

evolving contours of global hegemony, and the ongoing rivalry between these two economic powers shapes the future of the global economic landscape.

4.3. Discussion of the chapter, preliminary testing of some objectives, questions and hypotheses

Firstly, we fulfill the second objective of this thesis through the analysis conducted in Chapters 3 and 4. That is, we thoroughly examine the characteristics and dimensions of China's economic rise and compare its individual capabilities with those of the US. This assessment allows us to evaluate and contrast the relative weight of these two powers. Furthermore, Chapter 4 offers a valuable analysis that partially fulfills the primary objective of the thesis. Specifically, we analyze whether China can potentially replace the US as the global hegemonic economic power in terms of individual capabilities. We will complete this objective by analyzing structural power in Chapters 5 and 6.

Secondly, we can now address the initial questions posed in this thesis. Specifically, we aim to answer the question of the extent to which China has succeeded in catching up with or surpassing the US in terms of individual capabilities in the areas of productivity, technology, commerce, and finance.

Based on the preceding analysis, China has exhibited notable advancements in its potential to become a hegemonic economic power, as evidenced by its remarkable growth in production, technology, commerce, and finance. However, despite its rapid progress, China has yet to surpass the US across all critical domains. The US maintains a significant advantage in key areas crucial for global influence, such as international technological

innovation, financial power, and value-added trade. Consequently, while China possesses the potential to challenge US hegemony, it must broaden its capabilities comprehensively throughout its economy and enhance the intensity and efficiency of its growth.

For instance, China is leading the energy transition and 5G technology sectors; however, it faces considerable challenges in areas such as chip manufacturing. Furthermore, while China surpasses the US in terms of GDP when considering purchasing power parity (PPP), its productivity lags significantly behind that of the US. Nevertheless, recent trends indicate that China is rapidly closing the gap with the US in numerous domains, and it is expected to surpass the US in certain areas in the coming years. Although this trend is evident in productive, commercial, and even technological spheres, notable disparities remain in the financial sphere, particularly in monetary terms. The dollar continues to dominate, while the yuan is currently not an alternative.

While China's progress is notable, it must address its limitations and strive for a more comprehensive and efficient development across various sectors to solidify its position as a potential global hegemon.

On the other hand, in light of our empirical analysis, our results are in partial discordance with authors such as Jacques (2008), Lee (2018) and Mahbubani (2020), Dalio (2021), or Moyer et al. (2023) who propose a Chinese hegemony. Instead, our results align more closely with the views put forward by Nye (2020) and Schwartz (2021), who argue for the enduring strength of US hegemony. Similarly, our results lend credence to the skepticism expressed by Pettis (2013), Hung (2015), and Klein and Pettis (2020) regarding China's ability to outperform the US economically, given its domestic

imbalances and existing US power.

Our data also highlight the technological challenges for China laid out by Ding (2023), Rikap and Lundvall (2021), and Liu and Tsai (2020). These challenges include dependence on foreign technologies or translating technological development into the economy. However, China has made progress in sectors that will be crucial in the future and can help it threaten or dispute power with the US, such as 5G or technologies linked to new energy sectors.

Along these lines, in light of the results, China seems to be changing its economic model, although maintaining specific imbalances. The aim is to reduce dependence on investment and low-value-added exports, boost technological development, scale up the GVC, and boost domestic consumption. Of these objectives, China seems to be partly achieving those linked to scaling up GVC and technological development. However, it cannot improve domestic consumption, as seen in Chapter 3.

In the same vein, our findings reinforce the perspectives of Brooks (2019), Norrlöf and Reich (2015), and Shambaugh (2018), who argue that China's global reach has substantial limitations, calling into question its readiness to assume the mantle of hegemonic power. Nevertheless, our study does affirm Glaser's (2019) proposition that China is fostering gradual changes in the international order and establishing parallel institutions when current ones do not favor it.

Regarding the WTS debate, Arrighi (2007) posits that China's rise will deviate from previous challengers due to its introverted idiosyncrasies and trade-based relationships that have slowed military expansion. However, given the ongoing technological conflict and US containment of China, escalation of tensions seems inevitable. China's profit-driven logic could drive imperialist expansion, in line with the arguments of Pradella (2010), Katz (2011), and Molero-Simarro (2016).

We remain skeptical of the notions presented by Mearsheimer (2014, 2019), Pillsbury (2015), Allison (2017) and TCL theorists, and Friedberg (2020) that the rise of China endangers US hegemony and could incite a war of supremacy. Although there is potential for conflict, now the battle seems confined to the technological and commercial spheres. Although China's significant advances in production, trade, and technology play a considerable role in the global power struggle, it is still being determined whether China can pave a clear path to becoming the world's leading power, given the current US dominance and the imbalances that China has yet to rectify.

Thus, China's rise may challenge US hegemony, but it is far from overtaking the US in terms of material capabilities. However, the growing tensions between the two powers are materializing in a technological war stemming from China's ambition to change its production model and advances in crucial sectors such as 5G.

Thus, rather than a bipolar or multipolar world, the current and possibly future situation may be one where the US remains the hegemon but with more significant contestation and rivalry, with China as a counterposition that implies tensions, changes in the international order, bloc fights, but without the possibility of China having enough power to lead that international order or be the new economic hegemon.

4.4. Conclusions

In chapter four of this thesis, we implement the first step of our so-called individual-static methodology (see Chapter 2) to compare the material capabilities of China and the US regarding production, technology, trade, and finance. Our assessment of each country's material capabilities highlights China's significant progress in production, trade, and technology sectors. However, China still needs to overtake the US in these fields fully, and the financial gap between the two nations remains considerable.

This analysis suggests an intensification of technological rivalry between China and the US in recent years, with each country competing to preserve and expand its technological supremacy. This dynamism seems destined to significantly influence the future trajectory of the global technological landscape and the balance of power between the two nations. Although China's emergence as a global power has profound implications for the international system, the possibility of a bipolar or multipolar world still seems distant.

Our data suggest that China has developed sufficient potential to challenge the US hegemony in the future, or at least to emerge as a countervailing force to the US power as the world's second-largest economy. However, these conclusions are preliminary, based on the analysis of material capabilities. Later sections will compare and contrast them with the structural and dynamic analysis of hegemony.

In contrast to these findings, and in light of our empirical analysis, our results are in partial discordance with authors such as Jacques (2008), Lee (2018), Mahbubani (2020), Dalio (2021), and Moyer et al. (2023), who propose a Chinese hegemony. Our findings align more closely with the perspectives presented by Nye (2020) and Schwartz (2021), who argue for the continued strength of the US hegemony. Similarly, our results lend credence to the skepticism expressed by Pettis (2013), Hung (2015), and Klein and Pettis (2020) about China's ability to outperform the US economically, given its domestic imbalances.

Our data also highlight the technological challenges facing China, outlined by Ding (2023), Rikap and Lundvall (2021), and Liu and Tsai (2020). These challenges include dependence on foreign technologies and difficulty translating technological development across the economy. However, China has made progress in sectors that will be crucial and may help it threaten or contest power with the US (Malkin, 2020 Rikap

and Lundvall, 2021), such as 5G or technologies linked to new energy sectors.

In the same vein, our findings reinforce the perspectives of Brooks (2019), Norrlöf and Reich (2015), and Shambaugh (2018), who argue that China's global reach has substantial limitations, questioning its readiness to assume the mantle of hegemonic power. However, our study does affirm Glaser's (2019) proposition that China is fostering gradual changes in the international order and is establishing parallel institutions when current ones do not favor it.

Concerning the world system theory debate, Arrighi (2007) posits that China's rise will deviate from previous challenges due to its introverted idiosyncrasies and trade-based relationships that have slowed military expansion. However, given the US's ongoing technological rivalry and encirclement of China, an escalation of tensions seems inevitable. China-driven profit logic could lead to imperialist expansion, in line with the arguments of Pradella (2010), Katz (2011), and Molero-Simarro (2016).

We remain skeptical of the ideas presented by Mearsheimer (2014, 2019), Pillsbury (2015), Allison (2017), TCL theorists, and Friedberg (2020) that China's rise endangers the US hegemony and could incite a war of supremacy. Although there is potential for conflict, the battle seems confined to the technological and commercial spheres. While China's significant advances in production, trade, and technology give it a considerable role in the global power struggle, it is uncertain whether China can chart a clear path to becoming the world's leading power, given the current dominance of the US in the four areas of hegemony and the imbalances that China has yet to rectify.

Thus, China's emergence may challenge the US hegemony, but it is far from overtaking the US regarding material capabilities. However, the growing tensions between the two powers are materializing in a technological war stemming from China's ambition to change its production model and advances in crucial sectors such as 5G.

Therefore, instead of a bipolar or multipolar world, the current and possibly future situation may be one where the US remains the hegemon. However, with more significant contestation and rivalry, with China as a counterposition involving tensions, changes in the international order, and struggles between blocs, but without the possibility of China having sufficient power to lead that international order or be the new hegemon. However, the dynamic-structural analysis in Chapters 5 and 6 will allow a more precise answer to this debate. This global approach will allow a more solid answer to this thesis's hypothetical questions and objectives.

5. THE US-CHINA RACE FOR TECHNOLOGICAL HEGEMONY: A STRUCTURAL AND DYNAMIC ANALYSIS

ABSTRACT

This chapter delves into the second and third phases of the methodology presented in this thesis, focusing on the static-structural and dynamic-structural analysis within the realm of technology. We investigate the existing literature on technology power within the GVC and emphasize patents' significance in attaining a central position within this network. Our analysis centers on examining the respective positions of China and the US within the global patent network as a proxy of technological power, considering their centrality and the mechanisms driving network growth, namely the fit get richer and rich get richer phenomena. This chapter contributes to a deeper understanding of the role of technology in shaping hegemonic aspirations and provides valuable insights into the ongoing competition between China and the US.

5.1. Introduction

The main objective of this thesis is to study whether China has the potential to overtake the US as the hegemonic economic power. To this end, we have adopted a three-phase methodology, the first, the individual-static analysis, implemented at the empirical level in the previous Chapter 4, and the second and third, the static and dynamic structural analysis, which will be implemented in this chapter and Chapter 6.

In the previous chapter, the analysis of material capabilities has allowed us to identify each nation's relative strengths and vulnerabilities. In this sense, we highlight China's remarkable progress in all spheres, coming to compete with the US in the productive, commercial, and technological areas but still need to catch up with the US in the financial sphere. However, an approach focused solely on individual capabilities has inherent limitations when studying hegemony (see Chapter 2). Hence, we complement this analysis with a structural and dynamic perspective to provide a more holistic understanding.

In this chapter, we focus on technological hegemony by applying phases 2 and 3 of the methodology, i.e., static-structural and dynamic-structural analysis, using the global patent network as a proxy for international technological influence. By studying the position of China and the US within this network, we can assess their centrality and dissect the growth mechanisms that contribute to their technological power dynamics. From this point of view, this chapter on technological hegemony is a vital complement to the preceding chapter on individual material capabilities because it provides empirical evidence to test our hypotheses from a structural and dynamic power in a technological perspective. With Chapter 6, in which we analyze financial hegemony structurally and dynamically, we can test whether individual capabilities or structural power are more important in increasing global power and whether the former characteristic translates into the latter.

Thus, this chapter makes it possible to address several of the questions raised, objectives, and hypotheses of the thesis. First, it allows us to address, from a dynamic and structural point of view of technological hegemony, the central question of whether China has the potential to surpass the US as a hegemonic economic power. Secondly, this chapter analyzes the historical and current patterns of power growth in the global system from a technological perspective, in line with the third objective. In doing so, the aim is to determine which has more weight in the accumulation of technological power: the individual capabilities of each country or the previous position of structural power in the system. This consideration is crucial for predicting the likelihood of a hegemonic transition between China and the US. Moreover, from a technological point of view, this chapter tries to answer the question of what China's position in terms of structural power in the world system is compared to that of the US.

Previous analyses of China's rise, the comparison of its material capabilities with those of the US, and the escalation of tensions in the technological arena have underscored the importance of this sector as the main battleground between the two nations. It has been observed that China is making remarkable technological advances and is closing the gap with the US. In this context, it is vital to study the technological area as the rise and decline of great powers are part of broader cycles of economic boom and bust in which technological change is of fundamental importance (Thompson, 2020; Rikap & Lundvall, 2021). This takes on greater importance in the current context of the Fourth Industrial Revolution, in which China is making key technological breakthroughs (Malkin, 2020; Vlados, 2020; Rikap & Lundvall, 2021).

As mentioned in Chapter 3, to attain technological autonomy and leadership, the Chinese government has established initiatives such as MIC2025, Next Generation

Artificial Intelligence Development Plan, and China Standards 2035 (Malkin, 2020; Rikap & Lundvall, 2021). In response, the US government launched a counteroffensive against the Chinese advance starting in 2018 by limiting technology exports, adding significant Chinese companies to their Entity List, and restricting Chinese access to cutting-edge semiconductors containing US technology or the machinery, tools, and software required to produce them (Rikap & Lundvall, 2021; The Sullivan, 2022). The US government has also announced a strategy to slow down competitors and create a new national industrial policy to keep its lead in essential technologies, such as 5G, AI, and quantum computing (Sullivan, 2022).

Recent investigations by Starrs (2013, 2018), Schwartz (2017, 2019, 2022), Winecoff (2020), Malkin (2020), and Rikap and Lundvall (2021) serve as the basis for the current study. Winecoff (2020) argues that the structural power of the US remains strong despite the rise of China, and its leadership is evident in all areas (productive, financial, commercial, and knowledge). Starrs (2013, 2018) points to the persistent dominance of American multinational corporations in global value chains, and Schwartz (2017, 2019, 2022) agrees with Starrs that American multinational corporations' relative strength lies in the concentration of market power and their preponderance in the global marketplace for intellectual property rights (IPRs). However, Malkin (2020) suggests that while US hegemony remains constant, China's rise in the intangible global economy shows the existence of a latent, substantial threat to US technological hegemony. Additionally, Rikap and Lundvall (2021) argue that the world faces a major technological revolution that offers an opportunity to change global hegemony.

Technological hegemony is analyzed through patent recognitions between countries between 2001 and 2021. Companies and countries leading global value chains and technological development often file patents in multiple jurisdictions, granting them

221

market power and influence over others. Patent registration worldwide is used as a proxy for technological prowess, measuring a country's influence on others, and has been used in the literature with this aim on multiple occasions (Yang et al., 2019; Winecoff, 2020; Rikap, 2021). Innovation leaders hold the most international patents and exert significant control over technology use (Schneider-Petsinger et al., 2019; Rikap & Lundvall, 2021; Schwartz, 2021). As we explained in Chapter 2, As we explained in Chapter 2, the methodology used is NA, as it allows a structural approach to a complex set of relations to obtain a bird's-eye view of a system of relations as a whole and observe the position of each actor in the system. The volume of patent recognitions and the centrality of countries in the network are studied. The more central a country, the higher its international influence (Ding, 2018; Winecoff, 2020).

Furthermore, the dynamics of a network's growth can shed some light on its structure's present and future trends. In particular, studying the different growth patterns of a network suggests what has to happen to an actor to increase its relevance in the network in the future. Observing these mechanisms in the patent network growth provides a better understanding of whether the evolution of China and the US over time suggests a leadership succession.

Our results indicate an astonishing Chinese rise facing a strong US hegemony. The systematic functioning of the network indicates that the positions of influence and centrality are reinforced, strengthening the situation of countries with a better position ("the rich get richer") and preventing better individual behavior ("the fit get richer") from overcoming the structural mechanisms. This is what happens to US technological leadership. Despite China's rise, the US leadership position has been reinforced over time. However, China's technological growth has transformed it into a significant power, and it now benefits from these network's growth mechanisms serving the best-positioned

countries. This implies that the US has a new counter-power since China, unlike European countries, Japan, or South Korea, is not an allied power of the US.

Structural analysis of technological hegemony illuminates the enduring robustness of the US hegemony rather than examining individual capabilities, notwithstanding China's advancements. By probing network dynamics and growth mechanisms, we find that the dominant position of the US within the global technology structure remains unassailable. Despite China's significant growth in terms of individual capabilities and its augmented prominence within the global technology network, it has yet to pose a credible threat to the US.'s hegemonic position.

Finally, in line with our hypotheses, this chapter, from a technological point of view, reinforces the assumptions that China's economic growth in terms of GDP or trade weight does not necessarily translate into a commensurate increase in its structural power in the international system, at least in the technological area. Specifically, the NA reveals that while China has grown in individual capabilities, it has not experienced a corresponding increase in its structural power at the technological level and that the network growth mechanisms tend to reinforce US power.

The remainder of the chapter is organized as follows: Section 5.2 focuses on the determinants of technological hegemony, GVC, and IPRs; Section 5.3 explains the methodology and data used; Section 5.4 shows the results of our individual static, structural static, and structural dynamic structural analyses; and finally, Section 5.5 presents the conclusions.

5.2. Determinants of technological hegemony

In the study of hegemony transitions, technology plays a central role as changes in technological leadership and rules produce structural changes in the whole international

economic and social system (Strange, 1988; Cohen, 2016). Major historical shifts in global hegemony are accompanied by profound technological changes (Pérez & Soete, 1988; Freeman, 2007; Thompson, 2020; Rikap & Lundvall, 2021).

In the past, the development of information and communication technologies changed risk management in the financial structure, the internet changed the structure of knowledge, and the invention and development of nuclear weapons and satellites revolutionized the structure of international security (Cohen, 2016). At present, the contest for global hegemony is focused on the race for the technological leadership of the Fourth Industrial Revolution (Vlados, 2020; Xuetong, 2020). The generic question of whether China can replace the US as a hegemonic power can be framed in this context (Vlados, 2020; Rikap & Lundvall, 2021).

Operating within a world system, the capitalist economy is structured such that production fragments across various countries. This fragmentation is guided by a multitude of factors, among which the technological prowess of each nation is a key driver (Wallerstein, 1984; Rísquez, 2022). This system organizes countries into a hierarchical structure composed of a core, semi-periphery, and periphery, each exhibiting differing levels of innovation and technology diffusion (Li, 2021; Zhao, 2021).

In this vein, recent decades have borne witness to a fundamental transformation in the global production structure. This shift is marked by a fragmentation of production and the formation of global value chains (GVCs) (Rísquez, 2022). GVCs encapsulate the entirety of a product's lifecycle, from its initial conceptualization to its final consumption. The sequence of activities that make up this lifecycle can be spread across different companies and geographies.

In this scenario, production is no longer an insular process confined to a single firm or location; instead, it has become a process fragmented yet integrated on a global

224

scale. Companies are now capable of harnessing the unique competitive advantages offered by different locations, such as cost-effective labor, abundant natural resources, or specialized technical expertise (Rísquez, 2022).

In GVCs, innovation processes are usually decentralized among transnational agents. However, these processes are mainly led by the leading firm in the chain (Rikap, 2021; Rísquez, 2022). Competition among the leading entities gravitates more towards winning the "innovation race" than towards price competition. Leadership is established through the monopolization of innovations, exploiting the accompanying economic and technical dominance to orchestrate the entire production process (Rikap, 2021). This supremacy allows them to subordinate the rest of the entities in the chain, appropriating a substantial part of the value generated throughout the GVC (Rísquez, 2022).

In addition, Rísquez (2022) highlights the fundamental role of trade integration in this productive fragmentation. Intra-industry vertical trade has become increasingly common, reflecting the growing importance of GVCs and the role of trade in interconnecting the different elements of these chains. However, this progression has led to an imbalance of power, with hegemonic transnational corporations dictating the organization and control of GVCs, exerting significant influence over trading conditions and labor practices along the chain (Rikap, & Flacher, 2020).

On this basis, Rikap and Lundvall (2021) and Rabinovich (2023) postulate that contemporary capitalism is increasingly characterized by economic concentration based on intangible assets. According to WTO (2021), international trade in intangible assets is gaining ground over traditional exchanges of final products or raw materials between nations, which reinforces their relationship with GVCs. Companies trading intangibles earn royalties through licensing agreements on a range of intellectual properties, covering software, patented technologies, trademarks and designs. As noted in the WTO report,

IPRs, including patents, and other intangibles represent, on average, twice the value of tangible capital in products manufactured and traded throughout GVCs. Along these lines, Schwartz (2021) argued that the US sustains its hegemony because some US-based companies specialize in high value-added tasks. Since the 1990s, US institutions have had a decisive influence on the regulation of patents and standards at the global level, combined with the promotion of public/private innovation and the offshoring of lower value-added sectors. This shaped the country's productive structure by encouraging firms to have a high weight in intangible assets and human capital and a reduced amount of physical assets and employees (Schwartz, 2019).

As a result, US technology is the global reference with more patents in force than any other country and leads in exports and IPRs revenues (Schwartz, 2019). Schwartz (2021) observed that despite the US accounting for about 24% of the global GDP and China having 16% in 2018, 34.4% of the profits generated by all listed companies in the Forbes 2000 between 2005 and 2019 were from US companies, and only 11.6% were from Chinese ones.

By contrast, China is a country that has achieved high economic growth levels partly through low value-added products, inserting itself into the world system from the periphery and bottom of the global value chain (Liu & Tsai, 2020; Malkin, 2020; de Graaff, 2020).

Nevertheless, China has implemented different plans to transform its production model and influence in the world in the last decade (Petersen & Ueta, 2021). One of the Chinese government's objectives is to escape the so-called middle-income trap, which is the growth slowdown experienced by emerging countries unable to change their production model to climb up the global value chain and make the leap to the high-income category (Malkin, 2020). Faced with the Fourth Industrial Revolution, the Chinese

government saw a window of opportunity to assume technological leadership in the world and bet on the technological race (Xuetong, 2020). To this end, the Chinese authorities launched the *MIC2025* and the *China Standards 2035* plans (Malkin, 2020; Petersen & Ueta, 2021), which aim to lead the production and design of technologies marking the Fourth Industrial Revolution, such as AI, 5G, and quantum computing (Vlados, 2020). These will allow the country to gain autonomy and become less dependent on foreign technology. In addition, projects such as the *Belt and Road Initiative* and the *Digital Belt and Road* seek to expand China's influence in the world through their technology (Mayer & Zhang, 2021).

In order to boost its technology at the international level and influence multilateral standard institutions, the Chinese authorities are striving to strengthen its national patent system by bringing it in line with international IPRs protection standards (Central Committee of the Communist Party of China, 2021). The goal is to make the country a global standards leader by 2035, with 85% of its national standards comparable with international ones, making them more exportable (Central Committee of the Communist Party of China, 2021).

This plan is a new impetus to a long transformation process embedded in the *MIC2025*, XIII (2016–2020) and XIV (2021–2025) five-year plans. They both include the promotion of global standards as well as a change in strategy. Since the 1990s, the aim of Chinese authorities has been to replace imported global standards with those created in-house (Petersen & Ueta, 2021). For example, Beijing tried to impose its own national mobile communication standard and create an alternative to international Wi-Fi standards, going as far as requiring foreign companies to use its technology (Hong, 2017; Malkin 2020; Petersen & Ueta 2021). However, China's influence in this field was limited, and it ended up embodying international standards (Malkin 2020; Petersen &

Ueta 2021).

Global technological rules are crucial references for the development of a technological regime (Schneider-Petsinger et al., 2019). Countries and firms seek to set global standards to project influence (Schneider-Petsinger et al., 2019; Malkin, 2020; Petersen & Ueta, 2021). The competition to influence global technology standards reflects the desire of countries to achieve global economic dominance. The essence of this competition is to decide who sets the relevant standards and legislation and who follows these standards. The countries and companies that lead the global value network set the technological standards and define how products are manufactured and how future generations of technological inventions are marketed (Malkin, 2020). The followers must bear massive costs when they switch to adhere to the new standards, which affects their profits and revenues (Schneider-Petsinger et al., 2019).

In fact, patents in disruptive technologies often end up as so-called essential patents, i.e., patented technologies that fall under a technological norm or standard set by multilateral institutions, such as 3GPP in telecommunications, the International Electrotechnical Commission in electronics, and the International Organization for Standardization in industry and trade. Over the past half century, technological standard setting was dominated by the US, the European Union, and Japan, while Korea and China have become active in the past two decades (Malkin, 2020).

When it comes to quantifying exchanges of intangible assets, there is a major limitation in conventional trade and value-added statistics, including the most developed database, Trade in Value Added, from the OECD (WTO, 2021). In general, such statistics only capture manufacturing costs, as registered by customs, and overlook the value added by embedded intangible assets (WTO, 2021). For example, Foxconn Technology Co. Ltd., one of Apple's main assemblers, only reports the production cost of an iPhone to

Chinese customs when shipping it to the US (Xing, 2020), but its value is higher due to the embedded technology.

Statistical limitations in measuring the international trade of intangible assets present a serious obstacle in developing the literature focusing on the global value chain's structure and the hierarchical distribution of the countries and powers within it. It is essential to take the international exchanges of intangible assets into account (Schwartz, 2021). The study of economic hegemony today involves the study of the intangible economy (Schwartz, 2019; Malkin, 2020; Rikap, 2019, 2020; Rikap & Lundvall, 2021).

Some authors believe that the study of patents in international exchanges is useful to overcome this limitation since it allows the determination of countries at the center of the world's economy in terms of technological innovation, productive leadership, and profits (Schwartz, 2019; Malkin, 2020; WTO, 2021).

A patent is an exclusive right granted for an invention and entitles its holder to decide whether the invention may be used or exploited commercially by third parties. In exchange for this right, the patent holder makes the technical information relating to the invention available to the public (WIPO, 2023). Granting a patent license simply means that the patent holder authorizes another individual or organization to make, use, or sell their patented invention. This grant is made according to certain conditions (e.g., the amount and type of payment to be made by the licensee to the licensor) for a specific purpose in a specific territory, usually a country, for an agreed period (WIPO, 2023).

Patents are territorial rights that are valid in the country or region in which they have been granted according to the local laws, and they cannot be automatically enforced internationally. If the owner of a patent registered in a certain country wants to grant its license in another country, they must apply to register the patent in the second country, and the latter's authorities may or may not grant it.

Consequently, large amounts of data on patent recognitions (registers of foreign patents in national systems) are being created and can be considered the backbone of the international network of intangible assets (Schwartz, 2021; WTO, 2021; WIPO, 2023), as well as a proxy for technology diffusion (Yang et al., 2019; WIPO, 2023). Indeed, these data comprise an international network of relations that can proxy for the international network of technological influence. Studying the relative position of a country in the global patent recognition network makes it possible to study the technological influence of that country on the rest of the network (Yang et al., 2019). The leaders in innovation are those at the center of the patent recognition network; therefore, studying the network becomes a useful tool to analyze the technological influence of each country on others and the presence of a hegemon in the network. The country leading the world in the application of patents also has the capacity to establish the technological rules of the world (Malkin, 2020).

Derived from the above, this chapter builds on the empirical work of Winecoff (2020) and aims to contribute to the debate on hegemony between US and China in three steps: First, it proposes and implements an approach to measure technological influence at the global level, which overcomes the limitations of conventional international trade statistics. This is achieved through a static individual analysis of the international network of patent flows that allows us to analyze the structural power of each country in the network. The aim is to observe the hegemonic positions of the US and China and the roles played by the other actors in the network. Second, the static analysis is extended to comprehend structural characteristics by considering network centrality measures. Third, following Winecoff (2020) and the GT model developed by Pham et al. (2015, 2016, 2020), a dynamic analysis of hegemony, including its individual and structural aspects, is performed. By studying the mechanisms of network growth, we can observe the driving

forces of network evolution and distinguish between individual or structural mechanisms. This will shed some light on potential future scenarios in the face of possible changes in leadership.

5.3. Data and methodology

In this chapter, we focus on the application of the phase 2 and 3 of the methodology outlined in Chapter 2 to the analysis of technology. A key aspect of our approach is using transnational patent recognitions as a proxy for the diffusion of technology and the technological power of each country within the network. Patents are widely considered to be an important indicator of a country's innovative capacity and technological advancement, and by studying these cross-border patent recognitions, we can gain insights into the distribution of technological power among nations.

We will specifically use the data from the World Intellectual Property Organization's Intellectual Property Statistics Data Center, which collects information on transnational patent recognitions on a yearly basis. This dataset accounts for every patent registered by foreign companies in each country, and when considered collectively, these registers can be interpreted as a weighted directed network where nodes correspond to countries and weighted directed links describe the annual volume of transnational patent recognitions (Yang et al., 2019; WIPO, 2023).

The structure of the transnational patent network can be depicted as a weighted matrix denoted by $W=(W\_ij)\_(N * N)$, in which the weight W_ij illustrates the quantity of patent applications flowing from country i to country j (Yang et al., 2019). Since our analysis is centred on inter-country relationships, the self-loops are eliminated, i.e., $W\_ii= 0$ for all countries i. The connections in this network are directed, meaning they flow from node i to node j, therefore $W\_ij \neq W\_ji$. We can abstract the final network into a graph, G

$= (N, L)$, comprising a set of nodes (N) and a set of links (L) (Yang et al., 2019).

For the analysis in this chapter, we apply the PAFit model, based on the GT (General Temporal) framework as explained in Chapter 2, to the weighted networks of patent flows over time. Our aim is to measure the technological influence and hegemonic positions of the US and China and observe the driving forces behind the evolution of the network. This analysis will help us shape the most likely scenarios in the technological leadership arena in the face of possible changes. We use patent data from 2001 until 2021, providing a comprehensive view of the technological landscape over the past two decades.

To approach the technological hegemony, we compute and analyze different NA statistics around three dimensions: static individual, static structural, and dynamic structural. These dimensions describe the structure of the patent network, the positions and relationships of the countries, and the growth mechanisms of the network. By incorporating these three dimensions into our analysis, we can gain a more comprehensive understanding of the technological hegemony and its evolution over time, as well as the diffusion of technology and the technological power of each country within the network.

5.4. Results

We start by observing charges for the use of IPRs in Table 1. In 2021, the US shows a positive surplus of 78 billion dollars and China presents a deficit of -35 billion dollars. It reflects the strong position and quality of the US IPRs and China's dependence on external technology. This pattern seems to be reinforced over time.

Table 1. Charges for the use of intellectual property (balance of payments) in millions of dollars

Year/Country Name	United States	China	Canada	Germany	France	United Kingdom	India	Japan	Korea, Rep.	Netherlands
2001	24797	-1828	-1011	-1575	645	569	-280	-637	-2195	-581
2002	25834	-2981	-1904	-222	1167	-1061	-325	-599	-2246	-649
2003	28655	-3441	-2450	-536	711	-221	-526	1267	-2321	-430
2004	34125	-4260	-3273	-47	1438	871	-559	2057	-2681	-5897
2005	40340	-5164	-4086	-1465	2133	4140	-466	3002	-2684	-5897
2006	47924	-6430	-3724	-1921	1431	4456	-785	4595	-2662	-6499
2007	59882	-7849	-4327	-1192	5794	6996	-997	6551	-3508	-7137
2008	61908	-9749	-4794	-1297	5038	3873	-1381	7389	-3389	-7925
2009	56309	-10636	-5317	204	4284	4357	-1668	4863	-4100	-7717
2010	63853	-12209	-6917	1161	3610	3963	-2311	7912	-5995	-7848
2011	74141	-13963	-7063	3319	4799	3752	-2517	9817	-3016	-8979
2012	72808	-16705	-6970	3899	3988	3741	-3669	11995	-4714	-7509
2013	78530	-20146	-7232	9332	2115	7236	-3458	13756	-5482	-7571
2014	78818	-21937	-6949	12757	1778	7865	-4190	16395	-5004	-9169
2015	75973	-20938	-6645	13965	-417	8295	-4542	19443	-3502	-34661
2016	71007	-22818	-7053	17432	724	7667	-4941	18890	-2493	-10483
2017	73741	-23943	-6946	16938	994	9822	-5856	20340	-2415	-9485
2018	72083	-30222	-6407	20228	3393	10043	-7121	23577	-2063	-6576
2019	73799	-27766	-6298	20487	3330	8867	-7018	20376	-2157	654
2020	70795	-29288	-6486	20002	2395	7862	-5987	14765	-2993	2258
2021	77978	-35108	-7789	37626	2915	5700	-7761	18637	-3059	2066

Source: World Bank (2023).

In the first phase of our methodology, we will analyze, weight and centrally measures of the countries in the network. In the first approach to the patent network, we observe in Figure 35 a clear core-periphery structure is evident, implying that a few countries dominate the patent network, and therefore technology diffusion, across the world.

Figure 35. Global patent network in 2021
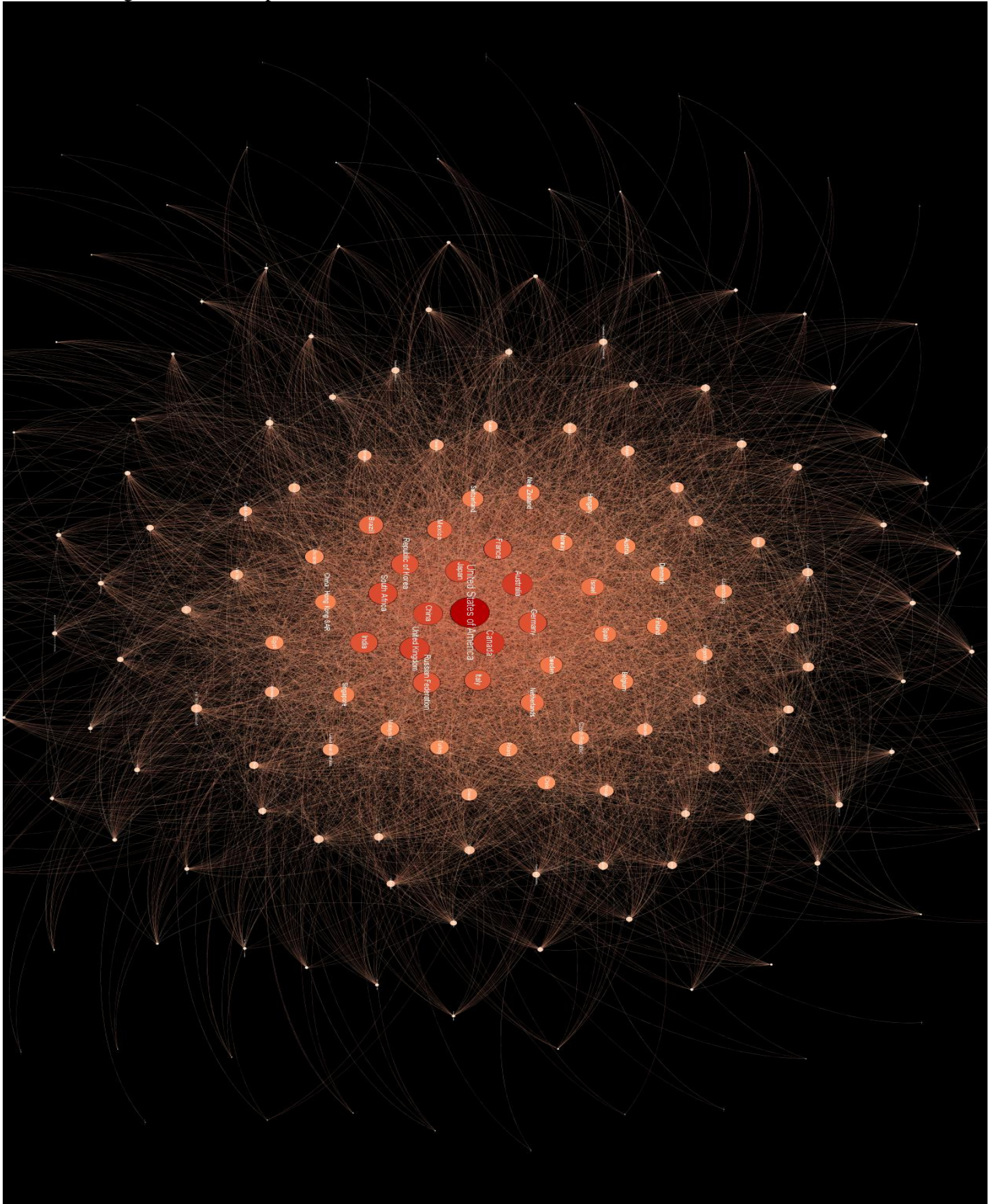
Source: WIPO (2023)

Figure 36. Countries in-strength and out-strength natural logarithms in the patent networks from 2001 to 2021
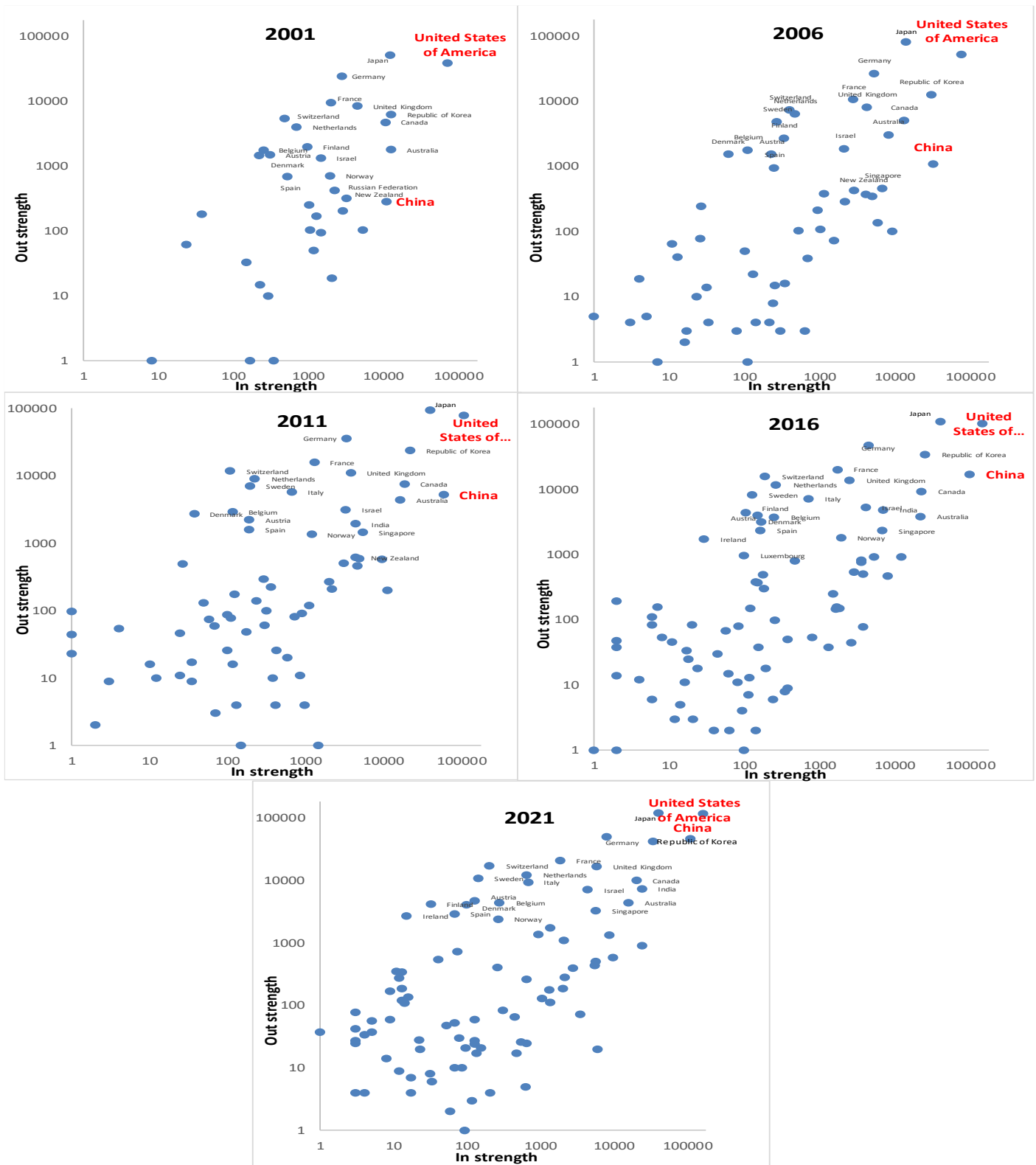
In addition, when in- and out-strength are added together (Figure 36), the US holds the lead during the whole era, which is indicative of its structural power in the patent network and can also be interpreted as the first sign of US technological hegemony.

Of particular interest is the progression of China toward the top of the ranking between 2001 and 2021. Its progress is unusual when compared to other countries, which positions varied marginally over time. In 2001, China already had a significant weight in receiving technology (ranked 5th out of 200 in in-strength) but could not be considered a technological reference when recognizing its own patents in the rest of the world (ranked 24th out of 200 in out-strength). Therefore, it is notable that it has been able to enter the race for top-ranking positions. In 2021, China is 2nd and 4th in the in-strength and out-strength rankings, respectively. It is also interesting to observe how it moved from a position as a technology receiver to a position as a technology creator.

However, given Chinese and US in-strength and out-strength growth paces, this first approach suggests a scenario where China's overtake of the US does not seem plausible in the short run.

In addition, the countries' values of eigenvector and betweenness centralities confirm the leadership position of the US and the constant gap between the US and other countries, with few exceptions, over time (Figure 37). Since these centrality measures are a proxy for the level of influence and the intermediating role of countries in the international flow of technological knowledge, respectively, the results allude that the US was dominating these interchanges in 2001 and continued to do so over the observed period. Many technological innovations pass through the US, and it maintains strict relationships with all countries with high technological levels.

Figure 37. Countries' eigenvector and betweenness centrality values in the patent networks from 2001 to 2021 (normalized values).
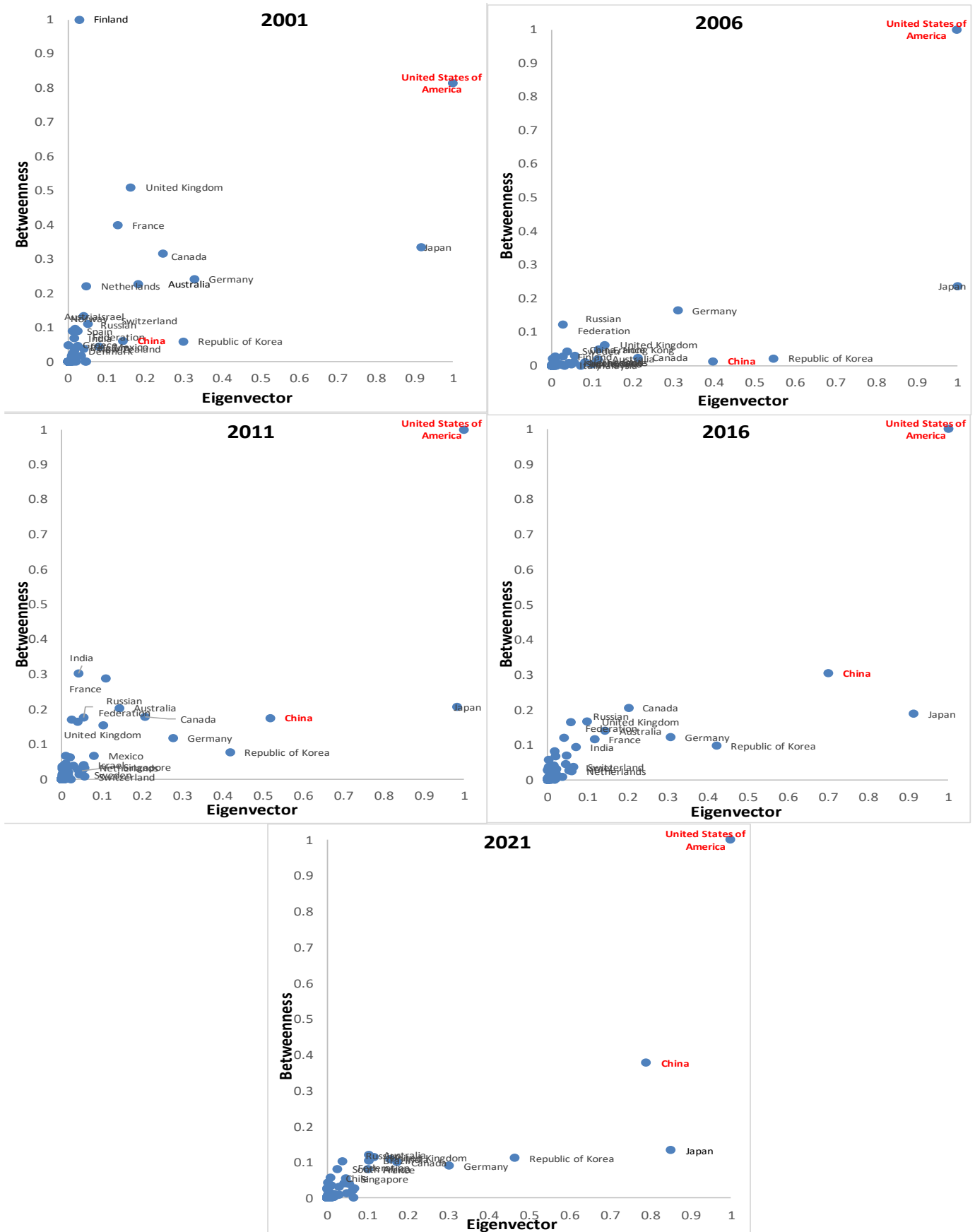
At the beginning of the observed period, Finland and the US occupy the top positions in betweenness centrality. In the case of eigenvector centrality, the US and Japan stood above the rest. By 2021, the absolute distance between the US and the second-most central country in terms of betweenness centrality, this time China, had expanded, with its value growing by a factor of 16. In the case of eigenvector centrality, the US separated itself even further from Japan.

By contrast, it is interesting to observe the relatively low relevance of China in 2001 in both cases (betweenness centrality and eigenvector centrality), as it occupied a position far from the core of the network. China clearly gained ground over time. Between 2001 and 2006, it emerged as the second-most central country in terms of betweenness centrality and gained the fourth position in eigenvector centrality. By 2021, China held a relevant role in the network, being the third most central country in terms of eigenvector and second in terms of betweenness centrality. However, its gap with the US remained wide.

Several implications arise from these findings. First, centrality measures confirm that technologically speaking, the US acts as a pathway to otherwise poorly connected countries; thus, it firmly controls the flow of information and access to technology to and from those countries. Consequently, the US has strong controlling and brokering power because it connects otherwise isolated countries in the network. This result is in line with Winecoff (2020), who stated that the US' centrality positions signal its hegemonic position, leaving other countries at a considerable distance. However, the role of China is becoming increasingly important in the network. It is establishing itself among the most powerful countries in the world, with a similar role to that played by Japan. Despite its considerable growth in centrality, the values observed suggest that China is not currently

a threat to US technological hegemony.

When it comes to the dynamic analysis, the estimated nodes' fitness is represented in Figure 38. It is centered around one, a sign of the existence of "the fit get richer" mechanism in the network growth process. However, the local maximum on the right tail of the distribution shows that some node obtains a higher-than-average number of new patents recognitions as a result of its higher-than-average fitness value.

Figure 39 represents the estimated preferential attachment function. It relates the growth of new patents recognized abroad (vertical axis) to the number of existing patents countries hold (horizontal axis) for the observed period. The increasing shape, with respect to the degree k, signals "the rich get richer." The function also presents a log-linear trend in line with the log-linear form k^α. The estimated preferential attachment exponent α equals 0.6307621, with two-sigma confidence intervals for alpha ranging from 0.6158368 to 0.6456873.

Figure 38. Network's fitness distribution from 2001 to 2021
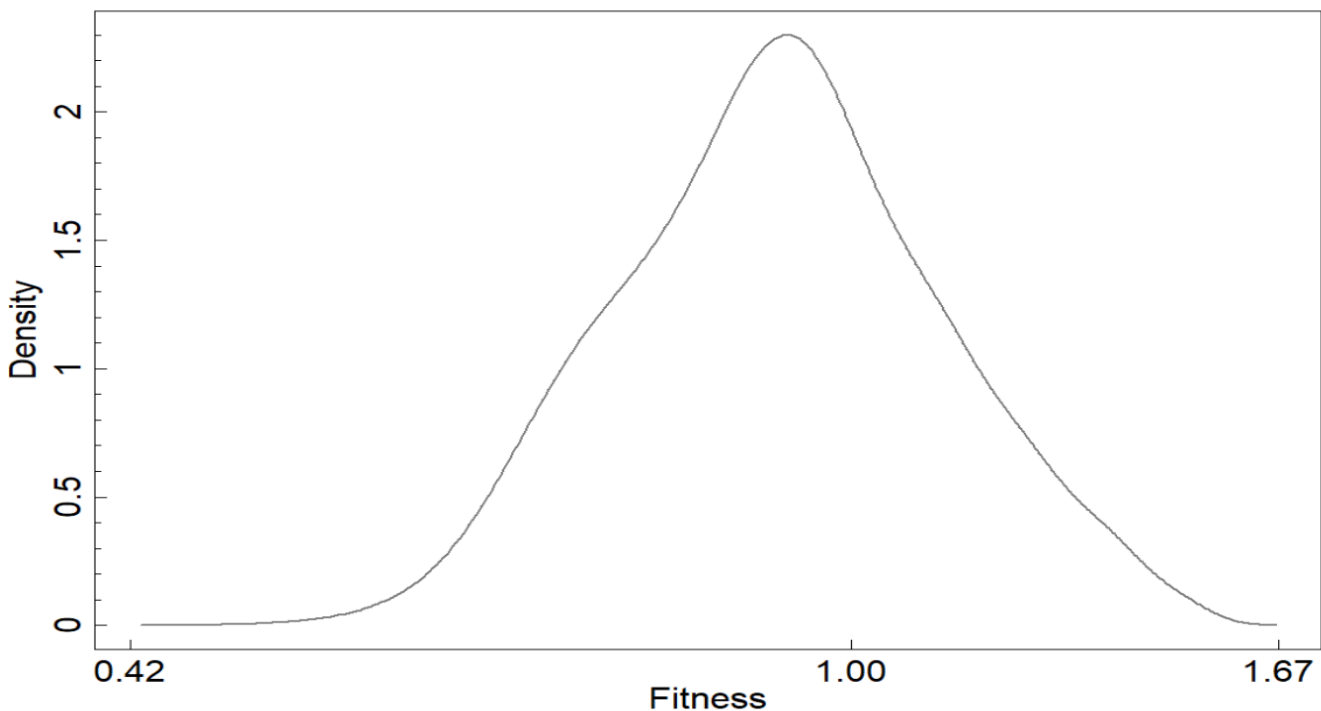
Source: WIPO (2023)

Figure 39. The preferential attachment function in the patent networks from 2001 to 2021
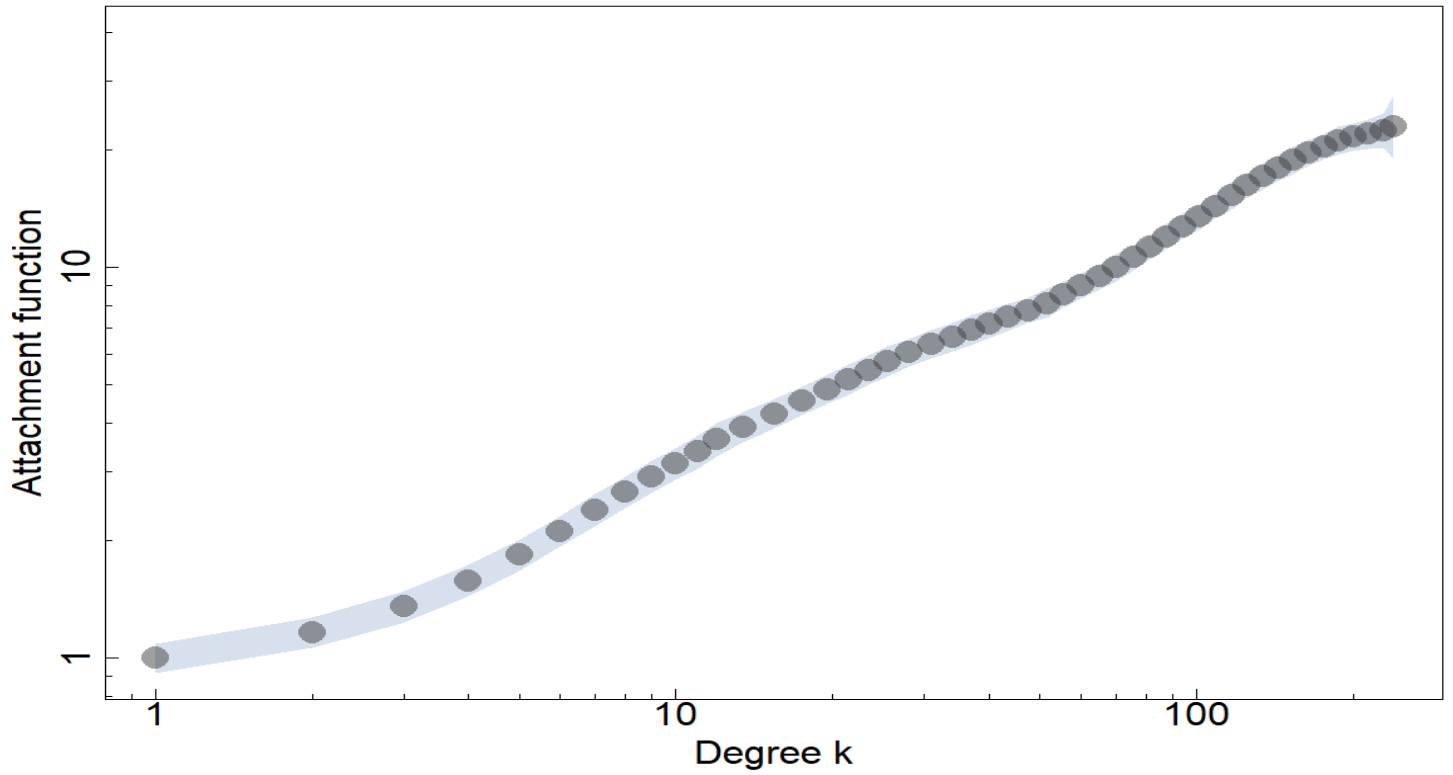
Source: WIPO (2023)

Figure 40. Contribution of preferential attachment to network growth
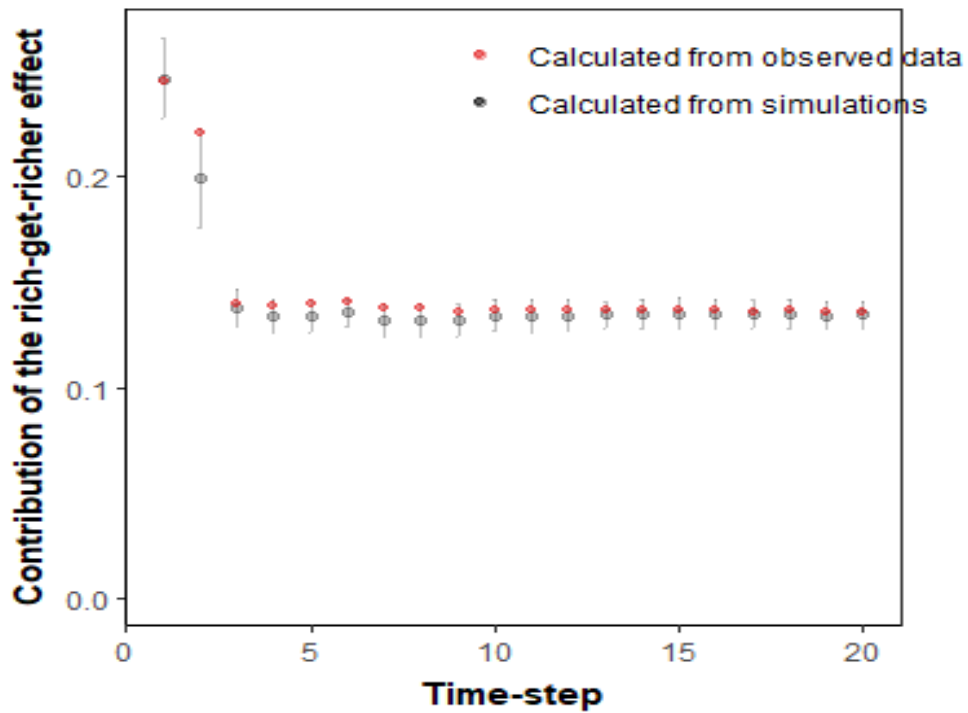
Source: WIPO (2023)

Figure 41 Contribution of fitness to network growth.
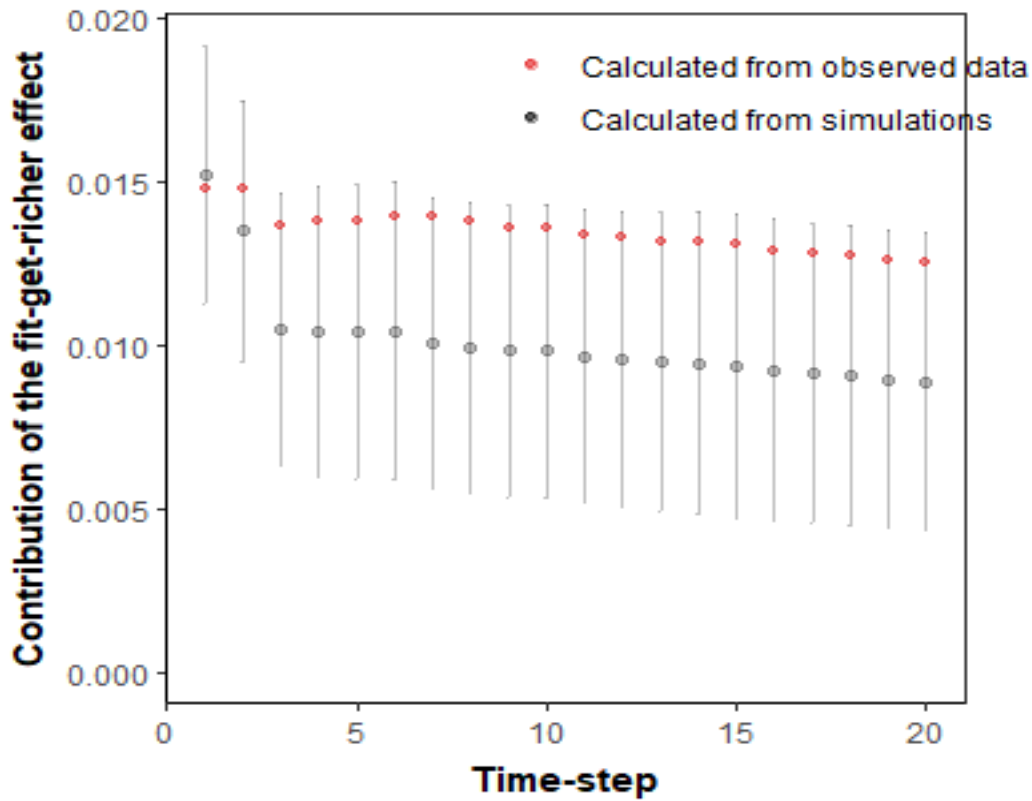
Source: WIPO (2023)

Once the co-existence of the two mechanisms in the network growth is confirmed, we observe their relative weights in Figure 40 and 41. The systemic mechanisms and structural positions seem to have more weight than individual state capabilities when establishing new relations, since preferential attachment has more weight than fitness in the recognition of new patents: newly recognized patent is easier to obtain because of a country's (central) position in the network rather than because of its intrinsic characteristics. This result is particularly interesting for countries aspiring to increase their international technological status. It implies that peripheral actors are unlikely to become central, and the central actors tend to strengthen their position over time. The effort in, for example, developing a technological sector or in growing intrinsic characteristics has to be extensive in order to overcome other countries that obtain new

patents from their incumbent position.

These results explain why we observe few changes in the countries' ranking over time and put into perspective the extraordinary growth of China toward the core of the patent network. Indeed, the static analysis shows that China was able to climb the international ladder of technological development and become one of the central technological powers between 2001 and 2021. China's plans to change its production model and increase its relevance in the global value chain seem to affect its position in the network. However, the prevalence of "the rich get richer" mechanism makes the Chinese movement from the periphery to the core of the network, due to its fitness, look exceptional.

On the one hand, US technological leadership benefits from its current position at the center of the knowledge-spreading network, and this fact reinforces the status quo that could be observed in the static analysis of the in- and out-strength, as well as in the analysis of the centrality measures. On the other hand, the rise of China, based on its country characteristics, occurred against the expectation for this network. The latter casts some doubts on the persistence of the status quo. In addition, China has been benefitting from its structural power vis-à-vis countries with worse positions since 2006. In the next few years, it could strengthen its position among some of the major powers thanks to the effect of the preferential attachment mechanism. Finally, we test the robustness of our network growth model through simulations. Figure 6 focuses on the validation of the rich-get-richer effect. In this graphical representation, we observe a consistent correspondence between our estimates and the true network data at each of the time steps. This consistency over the 100 simulated networks underlines the robustness of our modeling of this particular mechanism, reinforcing the reliability of our estimates. On the other hand, Figure 7 presents a similar demonstration for the fit-get-richer effect. As in Figure

6, the proximity between our estimates and the true data at each time step evidences the strength and accuracy of our model. Thus, the robustness of our model in reproducing the rich-get-richer and fit-get-richer mechanisms in the growth of the global patent network is corroborated, supporting its validity and usefulness for this type of analysis.

5.5.   Conclusions

In this Chapter, we analyzed technology hegemony from a dynamic-structural perspective, applying our methodology's second and third phases (see Chapter 2) to study the global patent network. This approach allowed us to circumvent the inherent limitations of classical trade data, which often fail to capture the importance of IPRs in the GVC.

The results of our study provide a partial answer to several research questions posed at the beginning of this thesis. We fulfill objective 3 for the technological domain, i.e., to analyze historical and current patterns of power growth in the global system in order to determine whether power accumulation is driven primarily by a country's capabilities ("fit get richer" mechanism) or whether it is driven to a greater extent by previous structural power position in the system ("rich get richer"), which could provide clues as to the likelihood of a hegemonic transition between China and the US. Thus, we can answer research questions 2,3 and 4 of this thesis (see Chapter 1). First, China's impressive economic growth and its advancement in technological capabilities, as evidenced by the increase in patent recognitions, have propelled it from a peripheral to a central position in the international patent network. However, it still lags far behind the US.

Second, in the technological domain, the growth mechanisms of the patent network revealed a pattern of "the rich getting richer," suggesting that positions of high

structural power are reinforced over time and that individual country fitness carries less weight. This implies that significant changes in the positions of leading countries are unlikely to occur, which would further reinforce US hegemony. China would have to break this dynamic by boosting its individual capabilities (fitness) in such a way as to compensate for the structural mechanisms, something it has achieved to reach second place, but still not enough to overtake the US.

These results would partially reinforce (from a technological point of view) the primary hypothesis, which indicates that China's economic growth does not necessarily translate into a proportional increase in its structural power in the international system. Moreover, from the technological point of view, it reinforces the assertion of the secondary hypotheses that the growth of China's individual capabilities has not translated into a proportional increase in its structural power in the technological area and the previous leading and central position of the US in the world system in this area has been more decisive in maintaining its hegemony, despite China's improvements in its individual material capabilities.

Thus, in light of the model results, although China's technological rise has transformed it into a significant global player, our findings confirm that it is not still positioned to challenge the US hegemony. Despite its technology sector's remarkable growth and newfound position at the network's core, China is still far from overtaking the US.

In short, this Chapter corroborates the claim that China represents the most critical challenge to the US hegemony. However, it demonstrates that the US maintains a formidable lead, especially regarding structural power within the global technological structure. Thus, while we recognize China's potential to increase its influence further, our analysis suggests that it is not yet poised to supplant the US as the world's hegemonic

power.

By linking the results of this Chapter with those of previous chapters, we can conclude that the United States maintains its hegemonic position in the technological sphere, both in terms of individual capabilities and structural power. This global understanding of hegemonic dynamics and the challenges posed by China will be expanded in the next Chapter, where we will delve deeper into financial power, applying phases 2 and 3 of our methodology similarly to Chapter 5.

6. THE US-CHINA RACE FOR FINANCIAL HEGEMONY: A STRUCTURAL AND DYNAMIC ANALYSIS

ABSTRACT

This chapter delves into the second and third phases of the methodology presented in this thesis, focusing on the static-structural and dynamic-structural analysis within finance. We investigate the existing literature on financial power within the global financial system, highlighting the factors that contribute to achieving a dominant position. Our analysis centers on examining the respective positions of China and the US within the global financial network, considering their centrality and the mechanisms driving network growth, such as the fit get richer and rich get richer phenomena. By thoroughly exploring these dynamics, we provide insights into the evolving landscape of financial power between China and the US. This chapter contributes to a deeper understanding of the role of finance in shaping hegemonic aspirations.

6.1. Introduction

This thesis's primary objective is to examine China's potential to surpass the US as the dominant economic power. A three-phase methodology has been adopted to achieve this objective, as outlined in Chapter 2. The first phase involves an empirical analysis at the individual level, which has been implemented in Chapter 4. The second and third phases entail a static and dynamic structural analysis. Chapter 5 focuses on the technological domain, while the present chapter addresses the finance sector.

Thus, this chapter makes it possible to address several of the questions raised, objectives, and hypotheses of the thesis. First, it allows us to address, from a dynamic and structural point of view of financial hegemony, the central question of whether China has the potential to surpass the US as a hegemonic economic power. Secondly, this chapter analyzes the historical and current patterns of power growth in the global system from a financial perspective, in line with the third objective. In doing so, the aim is to determine which has more weight in the accumulation of financial power: the individual capabilities of each country or the previous position of structural power in the system. This consideration is crucial for predicting the likelihood of a hegemonic transition between China and the US. Moreover, from a financial point of view, this chapter tries to answer the question of what China's position in terms of structural power in the world system is compared to that of the US.

The insights are drawn from comparing China's individual material capabilities with those of the US in Chapter 4 show that China closely competes with the US regarding productivity, trade, and technological hegemony. However, the US continues to maintain an overall lead in these areas. Additionally, the US has better individual capabilities in the financial area. Recognizing the inherent limitations of an approach focusing solely on individual capabilities, our analysis is expanded to incorporate a broader structural

perspective, enabling a more comprehensive understanding. This structural perspective, extensively explored in Chapter 5 concerning the technology sector, offers a detailed scrutiny of hegemony from a structural and dynamic viewpoint, applying phases 2 and 3 of our methodology (See Chapter 2). Thus, applying phases 2 and 3 in the technological area showed that China has considerably increased its structural power, but the US continues to lead. Moreover, the results showed that the growth of the network is mainly driven by the rich get richer mechanism, which makes it difficult for China to catch up with the US, and, in order to do so, it needs to compensate with a considerable increase in its material capabilities.

In the present chapter, we will apply phases 2 and 3 of our methodology to the global financial network, serving as a gauge for assessing global financial power. By examining the positions of China and the US within this network, we extract insights into their relative standings and decipher the growth mechanisms contributing to their power dynamics. This chapter, therefore, contributes to the overarching objective of assessing whether China possesses the potential to supplant the US as the primary international hegemonic power. Moreover, it satisfies the objectives of the thesis by applying an empirical framework for assessing financial hegemony, thereby enriching the study of China's economic rise and the influence of both powers in the financial sphere. This chapter also enables us to test the proposed hypotheses, analyzing whether China's economic growth corresponds to a proportional increase in its structural power, in this case within the global financial system, and determining if individual capabilities ensure more significant influence or hegemony at the international level.

The convergence of technology and finance is crucial for analyzing a potential hegemonic transition, as these areas are paramount in this context. On the one hand, within the current milieu of the fourth industrial revolution, a disruptive process,

dominance in areas such as AI, 5G, renewable energy, and other emerging technologies bestows significant economic and strategic advantages. As noted by authors such as Pérez and Soete (1988), Freeman (2007), Thompson (2020), and Rikap and Lundvall (2021), major historical shifts in global hegemony tend to be accompanied by profound technological changes. In this regard, the competition between the US and China in technology has become essential to their hegemonic rivalry. As both nations strive to spearhead the next wave of technological innovation, the dynamics of this competition could have significant implications for the global distribution of economic power.

In parallel, finance represents another critical sphere of influence in the global economy, where the ability to control and manage capital flows can shape a nation's hegemonic status. Giovanni Arrighi (1994) postulated that a transition towards financial dominance is expected in the later stages of hegemonic powers, allowing them to sustain their influence even as their productive edge wanes. In this context, the struggle for control over international financial institutions and the definition of the rules governing the global financial system is a significant battleground in the confrontation between China and the US. In this vein, if China manages to challenge the US's financial hegemony, it suggests a greater likelihood of an impending hegemonic shift.

Notably, in the debate regarding China's potential to achieve financial hegemony, one of the most extensively studied areas is precisely that. Though the US has been the world's hegemonic and financial power since World War II, speculation about the emergence of a multipolar monetary and financial order has grown since the dissolution of Bretton Woods and has intensified following the introduction of the euro and China's ascent (Mundell, 2002; Chinn & Frankel, 2008; Eichengreen, 2011; Subramanian, 2011; Layne, 2012; Armijo et al, 2020; Petry, 2023).

Alongside China's GDP growth and growing international significance, the

Chinese authorities have clearly intended to expand their financial influence. Recent works indicate China's intent to internationalize the yuan and replace the dollar, effectively ending US financial hegemony (Chorzempa, 2022; Fituni, 2022). However, comprehensive studies systematically examining the financial competition between China and the US are scant (Zhang, 2020). In this line, China is on the path to achieving a central position in the global financial system, with Hong Kong, Shanghai, and Beijing as principal financial centers, comparable to New York and London. China is expanding its financial influence through initiatives like the BRI and the AIIB (Chorzempa, 2022). These efforts, directly and indirectly, reinforce China's internal network of financial centers and strengthen the global connections of these centers.

This chapter addresses the gap in the literature by delving into the financial race between the US and China using a network perspective. In particular, it endeavors to illuminate the hegemony debate by quantifying countries' influence within the world system and examining the growth patterns of this influence from a financial standpoint, aiming to refine the accuracy of hegemony measurement. We analyze financial hegemony through the lens of financial flows between nations from 2001 to 2022. This approach enables us to gauge a country's financial influence over others. The applied methodology is NA (see Chapter 2), as it affords a structural approach to a complex network of relationships, offering a holistic view of a system of relations and revealing the position of each actor within this system. We examine the volume of financial flows and the centrality of countries in the network, with a higher degree of centrality denoting more significant international influence (Winecoff, 2020).

Furthermore, insight into a network's growth dynamics can elucidate present and potential future trends of its structure. Specifically, investigating the varying growth patterns of a network can indicate the necessary conditions for an actor to enhance its

relevance within the network over time. Analyzing these mechanisms concerning the growth of the patent network can deepen our understanding of whether the evolutionary trajectories of China and the US hint at a potential shift in leadership.

Our findings suggest that despite China's remarkable ascent, US hegemony endures robustly and is similar to the results of phases 2 and 3 of the methodology in the tech area. The network's systematic functioning reveals that positions of influence and centrality tend to be reinforced over time, intensifying the status of better-positioned countries—effectively illustrating the principle of "the rich get richer." This dynamic hinders superior individual performance ("the fit gets richer") from surpassing these structural mechanisms. Such is the case with US financial leadership; the US position has been bolstered over time despite China's emergence. These results underscore the importance of considering individual capabilities, interactions, and relationships within the global financial system. The US' historical leadership position and established centrality within the financial sector continue to fortify its hegemonic status. The global financial network underscores the significance of longstanding relationships and accumulated influence over time, further solidifying the US' dominance within the financial power structure.

The remainder of this chapter is structured as follows: Section 6.2 focuses on financial hegemony; Section 6.3 details the methodology and data used; Section 6.4 presents the results of our static-individual, static-structural, and dynamic-structural analyses; and finally, Section 6.5 concludes with a summary of our findings.

6.2. The US financial leadership and the rise of China

6.2.1. The foundations of financial dominance

Sandra Heep (2014) offers a compelling argument that posits two intertwined facets of

financial power: credit and monetary dimensions. Control of the credit provider, which includes banking, securities, or insurance, aligns with the first dimension, while the second relates to managing and exchanging currencies. Commanding these domains confers economic and geopolitical benefits, promoting domestic policy autonomy and enhancing international influence.

Countries wielding financial power experience diminished pressure from international markets, curtailing adjustments required due to imbalances in the balance of payments or "sudden stop" financial crises, amongst other factors (Cohen, 1998, Winecoff, 2020). Essentially, the proclivity of foreign entities to accept and retain a currency magnifies the issuing state's de facto borrowing capacity, thereby expanding its capability to defer balance of payments adjustments (Howell, 2020). This permits substantial macroeconomic flexibility, ensuring currency credibility and forestalling default risk (Fields & Vernengo, 2013; Howell, 2020). For instance, as a global financial and monetary hub, the US attracts capital flows during crises, unlike emerging economies that experience capital flight (Oatley et al., 2013; Oatley, 2015; Howell, 2020). Furthermore, financial power facilitates the projection of macroeconomic preferences globally through credit or monetary policy (Zhang, 2021, 2022). For example, the Federal Reserve's rate hikes influence other economies to follow suit (Howell, 2020).

Credit power also allows for incentivizing or imposing reforms in foreign countries in alignment with domestic interests (Copelovitch, 2010) and can be used to bolster defense spending (Winecoff, 2020). A country's creditworthiness can broaden or restrict the options available to other states. A country reliant on foreign credit and investment is susceptible to political influence from its creditors (Strange, 1988; Armijo et al., 2020), while a less dependent state enjoys greater autonomy. An instance of this is the US influencing the post-World War II reconstruction of Europe via the Marshall Plan

(Strange, 1988). China's BRI, launched in 2013, signals another shift in the global distribution of credit (see Chapter 3).

In this context, Petry (2023) maintains that controlling financial market infrastructures confers considerable power in shaping financial markets and exercising global financial hegemony. By interlinking various regions and entities, financial infrastructures streamline and influence socio-economic transactions and act as economic diplomacy tools for dominant players. Capital markets, especially since the 1980s, have become a critical financial infrastructure in the global economy, fostering robust economic growth. Stock exchanges, the providers of these infrastructures, actively shape the modus operandi of capital markets (Petry, 2023). They dictate which companies can be listed on their market, who can participate, and how investments are conducted, supervised, and penalized (Petry, 2023).

Moreover, stock exchanges can be a vital source of economic diplomacy for controlling countries (Petry, 2023). They can also exert considerable influence over other exchanges in other countries, whether through cooperative agreements to share technology and know-how or the acquisition of stakes in other exchanges. This control can extend to the rules and regulations governing the acquired exchange, offering the dominant exchange significant influence over financial market practices in the acquired exchange's country.

NASDAQ, for instance, has solidified its position as an industry leader and amplified its global financial infrastructures' influence by adopting electronic trading systems by many emerging and developing countries' exchanges (Petry, 2023). Recognition of NASDAQ's success and efficiency has led many stock exchanges in emerging and developing countries to adopt electronic trading systems to modernize their operations and attract more international investors. This adoption has transformed how

trading is conducted on these exchanges and enabled NASDAQ to consolidate its position as an industry leader and strengthen its influence over global financial infrastructures (Petry, 2023).

In short, having control over financial infrastructures and the technology that supports them is essential for exercising financial power and maintaining and expanding that power in the global economy (Petry, 2023). Countries or entities that control these infrastructures can influence the rules and norms of the financial market at the global level, which in turn can have significant implications for the distribution of financial power. Through this influence, the most influential players can shape global financial markets according to their interests and values.

In this vein, a central position in the global financial network is essential to enhance a state's direct influence over foreign actors (Kahler, 2009). Financial centrality makes attracting foreign actors to transact in their domestic capital markets possible. For example, American Depository Receipts (ADRs) allow foreign companies to list their shares on the New York Stock Exchange or NASDAQ, where they are listed, traded, and settled in US dollars (Armijo et al., 2020). In addition, domestic financial markets in financially powerful countries occupy a central position in the global financial network, providing safe assets (such as Treasury bonds) and deep markets with high levels of liquidity (Howell, 2020). The supply of safe assets is critical because it strengthens financial sector balance sheets and allows them to expand (Howell, 2020).

In this line, financial flows are linked to global factors operating through liquidity conditions and risk appetite. When central banks in financial centers change monetary policy, it makes domestic output, capital spending, consumer confidence, housing markets, and inflation contract and significantly affects global financial markets (Howell, 2020; Bruno & Shin, 2023). For example, prices of sensitive international assets collapse,

risk spreads widen, cross-border capital flows decline, and leverage decreases in domestic and international lending markets (Howell, 2020; Bruno & Shin, 2023).

Moreover, central financial markets provide relatively frictionless transactions and reliable resolution of contractual disputes (Armijo et al., 2020). For example, US financial power makes foreign banks comply with US regulations when doing business with the US, in addition to emulating US norms and standards by foreign regulators (Simmons, 2001; Drezner, 2007; Chey, 2014). Germain and Schwartz (2017) thus suggest that the US and Britain, whose jurisdiction is also a central financial node, were leading in constructing resolution regimes for global systemically important financial institutions.

Within the framework of financial power, the monetary area has been one of the most analyzed in the literature (Cohen 1998, 2016, Eichengreen 2008, 2011, Subramanian 2011; Chey, 2012; Cohen & Benney, 2014; Norrlöf, 2014). The hegemonic currency must fulfill three important conditions in the international monetary system. First, the currency must act as an intermediary for exchanges by serving as a means of payment for commercial and financial transactions for the private sector and as a currency for exchange interventions for the public sector. Second, the international currency must perform the role of a unit of account, being the main invoicing currency for world markets (as commodities or derivatives) and anchor currency for setting the exchange rates of any state. Third, the international currency must act as a store of value, both for private investors (banking markets or bonds) and central banks (official international reserves) (Aglietta & Coudert, 2015; Gourinchas et al., 2019; Armijo et al., 2020).

Moreover, the issuing country of the hegemonic currency has the essential function of providing liquidity to facilitate international transactions and to operate as an international safe-haven asset in crisis contexts (Gourinchas et al., 2019). To this end, the hegemon issues large amounts of nominally safe securities denominated in its currency,

which are absorbed by the rest of the world, given the demand for its liabilities by external agents, allowing external constraints to relax considerably (Gourinchas et al., 2019). In this sense, there is an interrelationship between credit and monetary power. International actors operate in the hegemon's financial markets and use its currency because of the depth, flexibility, transparency, and less discrimination between domestic and foreign residents, as is the case in the US today (Pettis, 2022). Likewise, Pettis (2022), Klein and Pettis (2020), and Germain and Schwartz (2017) argue that currently, an essential characteristic of the reserve currency issuer is that of an anchor of the global political economy that absorbs surplus savings globally. For example, in recent decades, the dollar surplus generated by the trade surplus in China or Germany has been recycled in the US financial system by purchasing dollar-denominated assets (Pettis, 2022).

This credit and monetary dominance generate structural or network effects. Those who use the hegemonic currency tend to develop vested interests in the stability of that currency or may support their countries' maintaining close ties with the issuer (Helleiner & Kirshner, 2009). Consequently, significant holdings of official foreign exchange reserves constitute a crucial defensive capability for countries that do not issue a global reserve currency, as they provide insurance against financial crises and reduce the borrower's susceptibility to creditor influence (Armijo et al., 2020). In addition, network effects feed back into the role of the dominant currency in the invoicing of international trade or through its function as a unit of account for the pricing of commodities or energy. (According to Gopinath & Itskhoki, 2021; Gopinath & Stein, 2021). The same is true for the role of the hegemonic currency as the currency of international finance, which creates a constant demand for dollars, as it is the currency used to settle these international liabilities (Howell, 2020).

The global financial hierarchy generates network effects (Kuehnlenz et al., 2023).

Most cross-border payments are now made through correspondent banking networks, where one (or more) intermediaries conduct financial transactions in a foreign country on behalf of domestic banks. Currencies used more regularly in international transactions and therefore rank higher in the currency hierarchy (such as the US dollar, the euro, or the pound sterling) tend to require fewer intermediaries for these transactions, resulting in shorter transaction chains. This, in turn, makes cross-border payments faster and more affordable. In contrast, emerging market currencies often require multiple intermediaries, resulting in longer transaction times and higher costs. Similarly, international investors, especially in times of financial uncertainty, are willing to hold a monetary asset that yields a small profit just for the advantage of being highly liquid, as this money can be used to pay for goods and services as well as to settle debts without losing its value (Kuehnlenz et al., 2023).

In addition, the current international monetary and financial structure relies heavily on SWIFT, a messaging system overseen by the G-10 central banks, including the Federal Reserve (Fed), which enables the interbank exchange of information related to international payments (Kuehnlenz et al., 2023). This network can also function as a weapon, as has been the case with the recent exclusion of Russian banks from SWIFT pushed by the EU, the US, Canada, and the UK as SWIFT members, in an attempt to hinder Russia's access to international financial markets.

6.2.2. US financial dominance

Since the Bretton Woods Agreements in the 1940s, the US has been the center of the international financial system, and the dollar plays the role of international currency with the Fed as the world's central bank (Miranda-Agrippino & Rey, 2021; Gourinchas & Rey,

2022; Kuehnlenz et al., 2023). Thus, the financial system is characterized by liberal rules that favor profit-oriented, poorly regulated, and internationally integrated financial markets and is guaranteed by the power of the US and replicates it (Drezner & McNamara, 2013; Petry, 2023). The provision of financial infrastructure within this global system is highly concentrated, with a small number of dominant exchanges shaping the capital markets on a global scale, primarily headquartered in the US, are for-profit companies that operate on a global scale and manage the largest, most prestigious and profitable markets, along with core products, indices, and technology (Drezner & McNamara, 2013; Petry, 2023), such as the New York Stock Exchange and NASDAQ. These exchanges serve as platforms where companies can raise capital by selling stocks and bonds, while investors can buy and sell these securities to generate profits.

Its financial system is the epicenter of global capital inflows and outflows, with the world's largest and most liquid stock and bond market (Howell, 2020). In particular, Treasury bonds are risk-free assets that provide interest and are readily exchangeable for cash (Pettis, 2022). These qualities attract foreign capital from private and central banks, corporations, and investment funds seeking to hoard their money abroad (Pettis, 2022). Moreover, the role of financial infrastructures in reproducing US hegemony is fundamental. Stock exchanges and other financial infrastructures facilitate the flow of capital into and within the US, which enables the growth of US businesses and fosters overall economic prosperity. In addition, because these infrastructures adhere to US rules and regulations, they also spread US financial practices worldwide. For example, companies wishing to list on US exchanges must comply with US financial reporting standards, which can influence their corporate governance and transparency practices.

The Federal Reserve's role as global lender of last resort has grown in importance recently (Miranda-Agrippino & Rey, 2021; Dafermos et al., 2022). In times of crisis, such

as 2008 or 2020 (Tooze, 2018; Dafermos et al., 2022), it provides liquidity to the rest of the economies, even if it leaves enemy countries out of these measures (Miranda-Agrippino & Rey, 2021) (Gourinchas & Rey, 2022) (Kuehnlenz et al., 2023). For example, in March 2020, the Federal Reserve provided liquidity to the central banks of Canada, the United Kingdom, Japan, Switzerland and the European Central Bank, Australia, Brazil, Denmark, South Korea, Mexico, Norway, New Zealand, Singapore, and Sweden, but not to China or Russia (Gourinchas & Rey, 2022). Moreover, the decisions affect global finance, as rate hikes or cuts mark financial cycles, and the rest of the central banks make their decisions in response to those of the Fed (Miranda-Agrippino & Rey, 2021; Howell, 2020).

The US and the US dollar play an essential role in international investment, foreign exchange reserves, and international banking, and as an anchor for the pricing of goods and financial assets (Gopinath, 2016; Gourinchas et al., 2019; Ilzetzki et al., 2019). Moreover, the dollar and the Fed's monetary policy play a central role in generating cycles in global trade and international finance, as a weak (strong) dollar exchange rate acts similarly to monetary easing (tightening) (Howell, 2020).

In fact, according to Bruno and Shin (2021, 2023), there has been an inverse relationship between the global export-to-GDP ratio and the dollar exchange rate over the past 20 years (Bruno and Shin, 2021, 2023). To participate in global value chains, companies need dollar financing to buy raw materials, pay wages, build inventories, and maintain accounts receivable. Access to credit in dollars depends mainly on the interest rate set by the Fed, the US central bank, as well as the exchange rate of the dollar against other currencies. When the Fed raises interest rates, or the dollar appreciates (price increases), credit in dollars becomes more expensive, and its supply is reduced. This makes it more challenging to finance commercial activities and can lead to a contraction

in world trade.

Conversely, when the Fed lowers rates or the dollar depreciates (lowers in price), dollar credit becomes cheaper, and its supply increases. This facilitates trade finance and can stimulate trade expansion. A stronger dollar benefits non-US companies exporting to the US, as their products become cheaper for US consumers. However, this advantage may be offset by the negative effect of a stronger dollar on dollar credit conditions. As credit becomes more expensive, many companies cannot maintain their business operations or reduce their profit margins (Howell, 2020; Bruno and Shin, 2021, 2023).

In this way, the US is more privileged than other countries (Miranda-Agrippino & Rey, 2021; Gourinchas & Rey, 2022). The preference of foreign actors to accept and hold the dollar increases the US' borrowing capacity, amplifying its ability to delay balance of payments adjustments and reducing its macroeconomic constraints (Germain & Schwartz, 2017). Indeed, the US has been running current account deficits for more than three decades thanks to the dollar's status as the dominant international currency. Moreover, this significantly increases fiscal and monetary policy autonomy and is a global power tool, as all domestic and international dollar transfers ultimately pass through the Federal Reserve's balance sheet.

Under the current configuration, the US has the power to disconnect a country from the grid of the international financial system, as has been the case with Russia after the invasion of Ukraine (Kuehnlenz et al., 2023).

Moreover, given the lack of liquidity in many other currency markets, the US dollar is also used to access other currencies, a process known as currency triangulation. This creates an inherent demand for the US dollar and an asymmetric relationship between currencies in the international monetary system, as emerging and developing markets also hold a large share of global GDP. However, their currencies account for little

weight (Kuehnlenz et al., 2023) mainly because there is no other economy in the world that can provide assets on the level of the US to operate as a global financial center (Kuehnlenz et al., 2023).

6.2.3. China as a new financial power

Historically, Chinese financial markets have operated under heavy regulation, with capital controls as the backbone of the country's growth model. Chinese authorities have tailored capital markets to fit their state capitalism model, where the Chinese Communist Party aims to maintain control over socioeconomic development. Instead of focusing on profit generation, Chinese markets are structured to meet state goals (Petry, 2023). In contrast to global exchanges, and profit-driven enterprises, Chinese exchanges are state entities incorporated into state structures and organized as non-profit entities (Petry, 2023). These controls have facilitated China's ability to sustain its export competitiveness through a devalued yuan while reducing the need to adjust the balance of payment surpluses (Choyleva & McMahon, 2022). Furthermore, China has been managing its monetary policy by holding substantial dollar reserves, which were reinvested into the US financial markets, primarily via Treasury bonds (Pettis, 2022). This tactic has enabled China to maintain relative financial autonomy (Heep, 2014).

Nevertheless, the very process of economic growth and China's entry into the WTO in 2001 has spurred a certain degree of liberalization, albeit with tighter controls than in other sectors, such as trade (Choyleva & McMahon, 2022). Since the early 1980s, China has directed its financial relationship with the outside world by establishing special economic zones to manage foreign investment (Molero-Simarro, 2014). The financial link with Hong Kong is particularly significant. China utilizes Hong Kong's foreign

exchange, equity, and debt markets to attract foreign funds, while international companies use Hong Kong as a springboard for expansion into the mainland. In 2021, 65% of foreign direct investment in and out of China was channeled through Hong Kong, and Chinese companies raised half of all initial public share offerings (IPOs) in Hong Kong. That same year, Chinese companies secured 25% of their US$131.8 billion offshore financing in US dollars through the Hong Kong debt market. As for the foreign exchange market, Hong Kong is the world's largest offshore yuan liquidity pool (Hong Kong Monetary Authority, 2022).

The systems linking the Hong Kong, Shanghai, and Shenzhen stock exchanges are the primary gateway for foreigners to purchase mainland Chinese shares. In this line, China's extraordinary economic growth over recent decades underpins the top global rankings of its financial centers in Hong Kong, Shanghai, and Beijing (Choyleva & McMahon, 2022). Hong Kong serves as China's window to global capital, leading the Asia-Pacific region and ranking among the top three global financial centers alongside London and New York (Choyleva & McMahon, 2022). Shanghai functions as China's commercial and financial hub, while Beijing represents the country's political and regulatory center (Choyleva & McMahon, 2022).

However, capital controls limit China's momentum as an international financial center. In turn, they hold back the establishment of its domestic currency, the yuan, as an international store of value, as this would also require the internationalization of financial markets (Choyleva & McMahon, 2022). Moreover, its exposure to the US financial system and the decisions of the Federal Reserve, as well as the possibility of sanctions through the freezing of dollar transactions, limit China's financial power (Zhang, 2020). The authorities are aware of this limitation and, for more than a decade, have announced the need to change the production model, liberalize the financial system, capital controls

and boost the internationalization of the yuan (Molero-Simarro, 2014; Zhang, 2020; Choyleva & McMahon, 2022). Specifically, to maintain sufficiently high growth rates, the government seeks to boost the share of consumption in GDP and imports (Choyleva & McMahon, 2022). A consequence of this objective is financial liberalization, as the shift from an export-led and investment-led growth model to a consumption-led one drives the yuan's internationalization (Barredo-Zuriarrain & Molero-Simarro, 2023).

In this vein, since 2009, China has implemented measures to boost and internationalize its financial and monetary system (Choyleva & McMahon, 2022; Barredo-Zuriarrain & Molero-Simarro, 2023). Beijing is encouraging foreign investment in its financial markets by gradually removing restrictions and creating a more investment-friendly environment with deeper, broader, and more liquid capital markets. The pace at which companies are going public in the Shenzhen and Shanghai markets has been accelerated, and exchanges for small and technology companies have been set up to make them deeper. Beijing is introducing a more comprehensive range of financial products that span the risk-return spectrum to make them broader. Moreover, Beijing uses pension reforms, real estate, and wealth management products to increase liquidity to direct more funds into equity and bond markets (Choyleva & McMahon, 2022; Barredo-Zuriarrain & Molero-Simarro, 2023).

Moreover, China aims to bolster its financial power within the BRI (Choyleva & McMahon, 2022; Petry, 2023). Rather than abiding by profit-driven principles and assimilating into the international fabric of American-led exchanges, Chinese exchanges stimulate the development of capital markets that uphold distinct norms and benchmarks (Petry, 2023). In doing so, they foster investments in projects tied to the BRI by enlisting associated firms, offering prolonged funding for BRI-related ventures, and merging these countries into China's financial networks (Petry, 2023). This strategy enables China to

design and enact financial systems and structures mutually beneficial to China and its BRI affiliates, significantly modifying the global financial power dynamic.

Besides granting direct loans to nations, which could amplify their debt load, China promotes investment in equity markets (Petry, 2023). This method ensures more enduring funding, diversifies risk, and empowers China to wield amplified influence via stock proprietorship. Additionally, by injecting capital into the financial infrastructure of BRI countries, China can enhance its leverage over these markets. This initiative simplifies the entry of Chinese corporations into these markets and endows China with a more powerful bargaining leverage with BRI nations (Petry, 2023). Furthermore, by exporting its savoir-faire and economic prototype to these nations, China fortifies its status as a nascent economic juggernaut internationally. Chinese equity markets are executing many strategies, including buying out other stock exchanges, forging alliances between exchanges, devising mechanisms to magnetize Chinese investment, and entering into memorandums of understanding or collaboration agreements (Petry, 2023). State-controlled Chinese exchanges expedite investments in BRI ventures and allure Chinese investors to BRI markets, thereby influencing the operation of these markets. As Petry (2023) demonstrated, China has sought to escalate its financial prowess through initiatives with countries such as Pakistan, Kazakhstan, and Bangladesh. Incorporating these nations into Chinese financial circuits could engender a parallel system of capital markets with Chinese regulations. This new system could either supplant or coexist with American-centric markets.

At the monetary level, Beijing has reached agreements with countries such as Russia, Iran, Pakistan, and Saudi Arabia to trade in yuan and has signed bilateral and multilateral agreements to extend swap lines with at least 36 countries (Choyleva & McMahon, 2022; Barredo-Zuriarrain & Molero-Simarro, 2023). In the context of China-

Africa cooperation, the internationalization of the yuan has been particularly successful, focusing on removing obstacles resulting from foreign currency shortages in African economies and introducing new financial instruments and solutions that allow taking agreements out of the control of the US dollar and other Western-controlled compensation schemes (Fituni, 2022). Along these lines, the Chinese government has also tried to promote the influence of its currency through multilateral institutions. In this sense, its inclusion in the basket of currencies that make up the Special Drawing Rights of the IMF and cooperation agreements with countries and international financial institutions such as the World Bank, the European Bank for Reconstruction and Development, or the NDB of the BRICS (Barredo-Zuriarrain & Molero-Simarro, 2023) has been particularly relevant. For the same purpose, the Chinese government has also used the Belt and Road Initiative, an investment, lending, and trade project with agreements with more than 100 countries and institutions in Africa, Europe, and Asia (Lai, 2020). While it is true that most of the loans in this initiative are in dollars, the government seeks to increase the number of loans in yuan (Choyleva & McMahon, 2022).

Another key measure for the internationalization of its currency is the launch of the digital yuan. Central banks' digital currencies could be used for cross-border transactions and reduce their reliance on the inefficient correspondent banking network and over-reliance on the US dollar for currency triangulation. In addition, it would increase efficiency and reduce the costs of international settlements. In the case of the digital yuan, its use would allow China to increase cross-border payments in its currency by avoiding Western technology, such as the Swift messaging system. For example, China's digital currency could, in the future, become a vehicle currency for trade between China and its trading partners, pushing the digital yuan into reserve currency territory (Carney, 2019).

However, although China is one of the most advanced countries in the race for so-called central bank digital currencies, it still needs to be widely implemented. According to the People's Bank of China, there are already 13.61 billion digital yuan in circulation, about 15% more than a year ago. However, it only accounts for 0.13% of all yuan in circulation (People's Bank of the Republic of China, 2023).

In summary, China has recently been boosting its financial and monetary power globally. Along these lines, this chapter aims to assess whether China's financial power has grown significantly and is on a trajectory to surpass or is gradually converging with that of the US.

6.3. Data and Metodology

This chapter builds on the methodological framework presented in Chapter 2 for constructing and analyzing the global financial network and is already applied in Chapter 5 for the technological area. In this case, the global financial system, as characterized by Oatley et al. (2015), is a complex adaptive system in which agents interact in a decentralized manner, producing a structured and durable collective outcome. Through this system, individual positions within the collective structure inform both the behavior of the agents and the structure itself. This system is expressed through cross-border financial flows, which are crucial for assessing a country's financial influence and connectivity within the global economy.

We use data from the IMF Coordinated Portfolio Investment Survey (CPIS) to examine this global financial network, specifically *Reported Portfolio Investment in Assets by Nonresident Issuing Economy: Total Portfolio Investment* for the 2001-2022 period. Portfolio investment refers to acquiring securities issued by non-resident entities, including stocks, bonds, and notes. These data allow us to trace financial interconnections

between economies and cross-border capital flows. It is essential to note the absence of China-specific data through 2015; however, data exist for Hong Kong across the sample, a key node for financial investments in China. Historically, Hong Kong has acted as an essential gateway for financial investments in China, underscoring its relevance in our study. Including Hong Kong in our study enriches our understanding of the evolution of financial hegemony between China and the US.

We use this IMF data, covering the period from 2001 to 2022, to construct a weighted directed network. The nodes denote countries, and the weighted directed links represent the annual volume of *Portfolio Investment in Assets*. In the weighted matrix *W* = (*W_ij*)_(N * N), the weights (*W_ij*) denote the volume of financial flows from country *i* to country *j*, with *W_ii* = 0, emphasizing our focus on cross-border relationships. Since the network is directed, *W_ij* ≠ *W_ji*, suggesting that the financial flow from country *i* to country *j* is not necessarily the same as that from country *j* to country *i*.

Our objective is to quantify the financial influence and hegemonic positions of the major players in the global financial system and to identify the factors driving network evolution. This examination will help to anticipate possible scenarios in financial leadership amidst possible changes. To analyze financial hegemony, we compute and evaluate various NA statistics within three dimensions: individual-static, structural-static, and structural-dynamic. These dimensions encompass financial network structure, country positions and relationships, and network growth mechanisms. Specifically, as we show in Chapter 2, we calculate the in-strength and out-strength of each country and the betweenness and eigenvector centrality. In addition, we employ the PAFit model, based on the GT framework to study which mechanisms drive network growth, whether the fit get richer, or the rich get richer. The integration of these three dimensions in our analysis allows us to better understand financial hegemony and its temporal evolution, as well as

the distribution of financial power among the countries in the network.

6.4. Results

First, our previous analysis of individual material capabilities (see Chapter 4) revealed that the US holds a commanding lead in the global equity market, with 59.9% of total global equity market value. Japan is a distant second with 6.2%, followed by the United Kingdom with 3.9%, and China holding a mere 3.6%. In the bond market, the overall size is approximately $128.3 trillion. This market is dominated by the US, China, and Japan, accounting for 62% of the global market. The US and China also have the most significant presence in the global corporate bond market, representing 45% of the total market.

Regarding foreign exchange reserves, the US dollar has steadily declined over the past two decades. However, it remains the dominant currency in central banks' foreign exchange reserve portfolios. Traditional reserve currencies, such as the euro, the yen, and the pound sterling, have seen limited growth, while alternative currencies, such as the Chinese yuan, have slightly increased. However, the yuan only accounts for 2.7% of global foreign exchange reserves. The US dollar is also the most used currency for payments, involved in 42% of transactions. The Chinese yuan trails significantly, involved in just 2.44% of transactions. The dollar also dominates the foreign exchange market, being part of around 90% of currency exchanges. The Chinese yuan's presence is still relatively small at 7%, but it has grown from just 1% in 2010.

Building on that foundation, we now move beyond individual capabilities, shifting our focus to a structural analysis of financial hegemony. This approach allows us to examine the interactions and relationships within the global financial system. It provides a more comprehensive evaluation of the prospects for a hegemonic transition between China and the US.

Figure 42. Countries in-strength and out-strength natural logarithms in the financial networks from 2001 to 2022
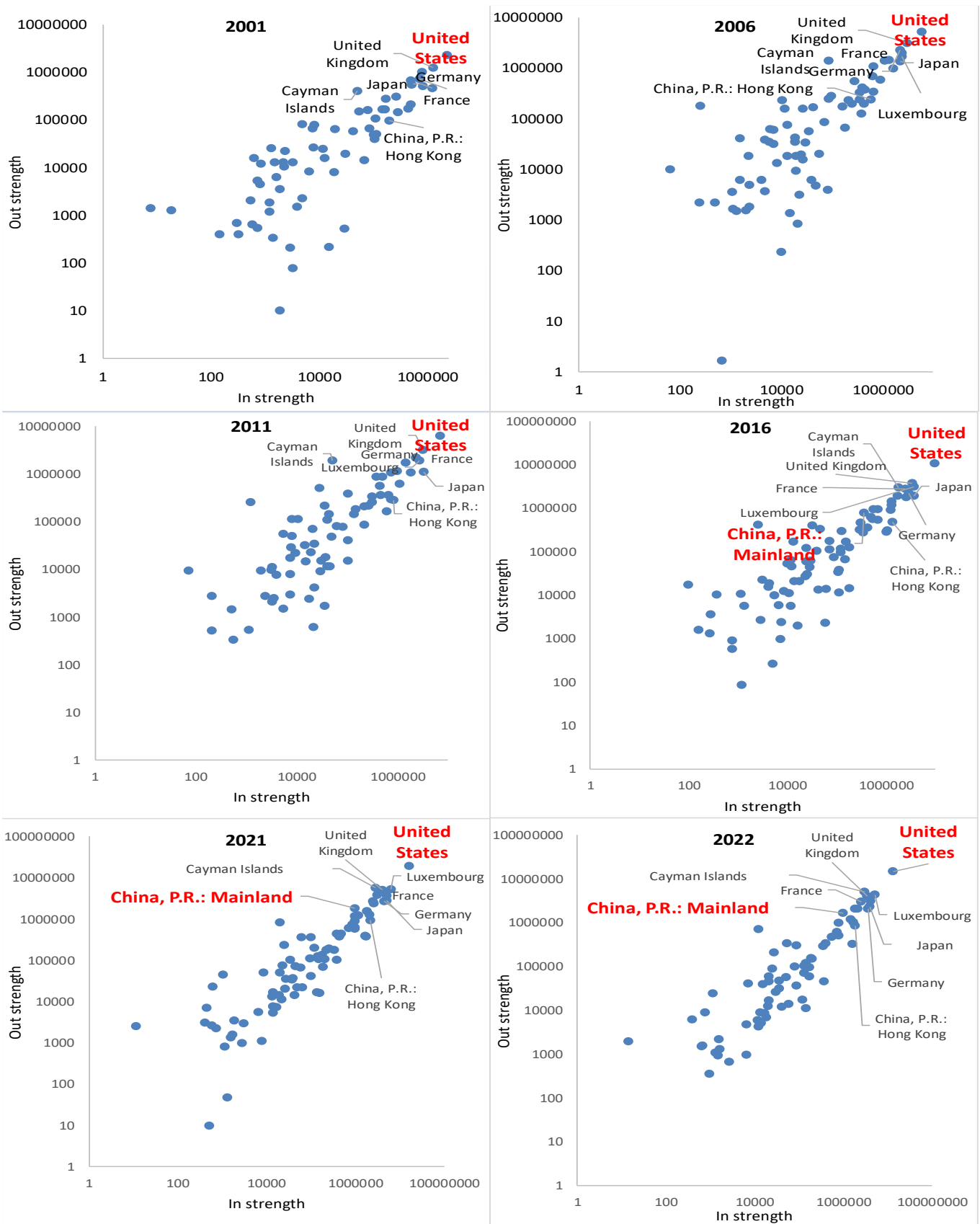
Source: IMF (2023)

Moreover, in the second phase of our analysis, we analyze the weight and centrality positions of the countries. The consistent position of the US at the top of in-strength and out-strength rankings signals its structural power in the financial network. It is also the first sign of US financial hegemony (Figure 42). Of particular interest is China's progression. In 2016, China already had a significant weight in receiving capital (22nd out of 245 in-strength) and sending capital (16th out of 245 out-strength). It is, therefore, remarkable that it has been able to enter the race for the top positions. In 2022, China ranks 15th and 11th in the in-strength and out-strength rankings, respectively. However, it is essential to examine the role of Hong Kong as its significant relation with China to canalize international financial investment. In 2002, Hong Kong had a significant weight in receiving capital (13th out of 245 in-strength) and sending capital (20th out of 245 out-strength). In 2022, it ranked 10th and 16th in the in-strength and out-strength rankings, respectively. If we sum the data from China and Hong Kong, in 2022, it ranks 8th and 7th, respectively.

However, given the growth rates of in-strength and out-strength of China and the US, this first approximation suggests a scenario in which China overtaking the US does not seem plausible in the short term.

On the other hand, it is also essential to take into account the role of countries that are tax havens. Tax havens affect tax collection and the structure and stability of the global financial network. By facilitating the diversion and accumulation of portfolio investments, tax havens create distortions in the measurements of countries' economic and financial power. For instance, Luxembourg and the Cayman Islands ranked second and 7th in the in-strength of portfolio investment in 2022 and 3rd and 2nd in the out-strength. However, these countries are not actual sources or destinations of investment but mere intermediaries connecting investors with securities issuers. Three of the four

most significant portfolio investments worldwide involve the US with the Cayman Islands or Luxembourg. Therefore, their weight in the network reflects not their ability to influence global financial decisions but their role in facilitating tax avoidance and financial opacity.

Figure 43: Countries' eigenvector and betweenness centrality values in the financial networks from 2001 to 2022 (normalized values).
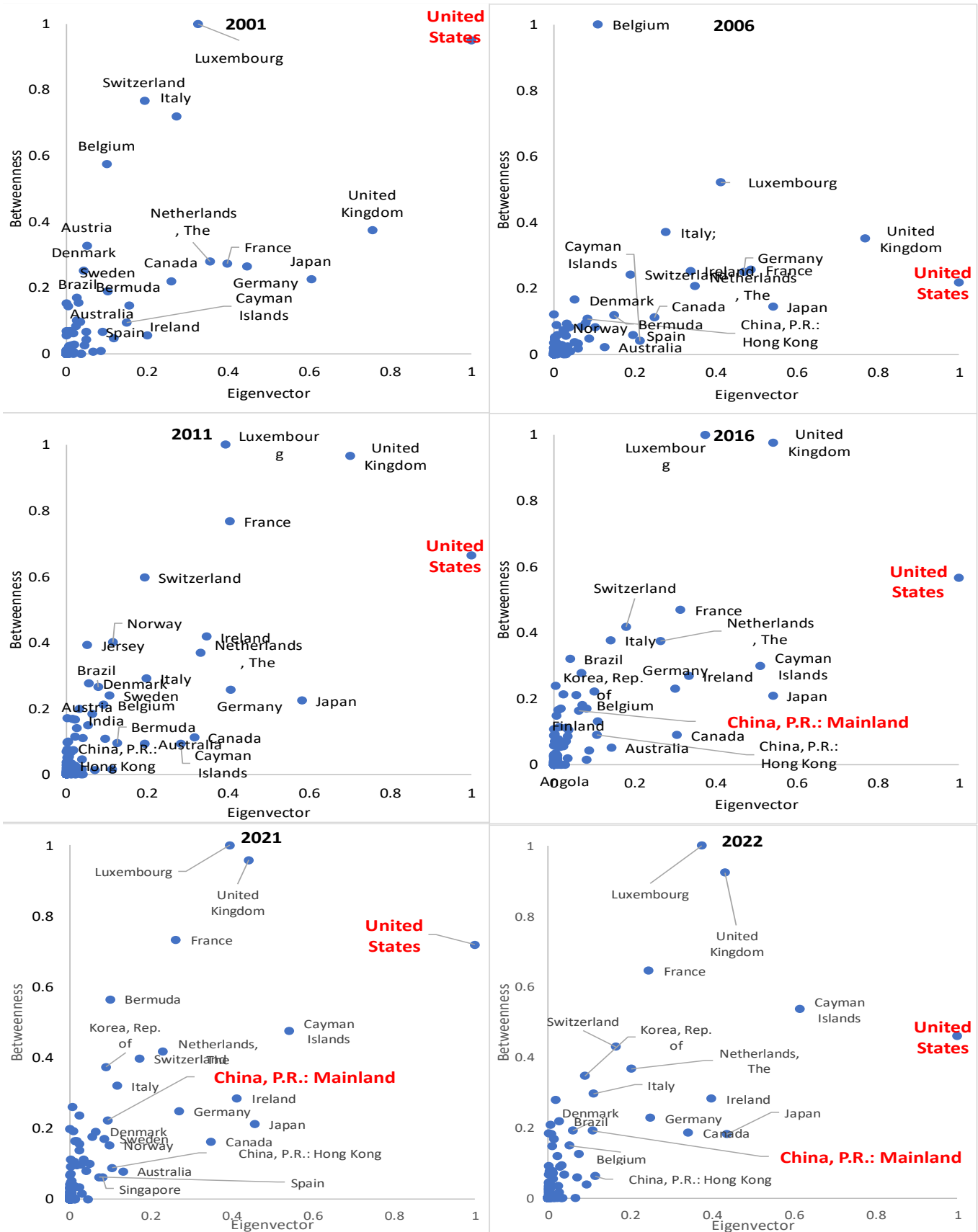
In addition, we analyzed the countries' values of eigenvector and betweenness centralities (Figure 43). Concerning eigenvector centrality, the US leads throughout the period, reflecting its dominant position in portfolio investment. However, we also noted significant shifts in the rankings of other countries. In 2022, the Cayman Islands held the second position, a known tax haven that channels a significant portion of US investments. Japan holds the third position, maintaining its relevance since 2001, when it held the same rank. Germany is in fourth place, descending from the second position in 2001, followed by the United Kingdom in the fifth position, another significant financial hub that has lost influence since 2001 when it held the second rank. In 2022, China and Hong Kong ranked 12th and 14th, respectively, showing progression since 2016, when China first entered the data at the 22nd position, and Hong Kong was 15th. These figures suggest that China and Hong Kong are increasing their connections with the network's most significant countries, though they are still far from matching the US.

Regarding betweenness centrality, we observe a higher variability in the results, indicating that no single country dominates in network mediation. Luxembourg is the only country standing out for its stability, leading the indicator in 2001, 2011, 2016, 2021, and 2022. Luxembourg is another tax haven mediating between investors and security issuers. The US was close to Luxembourg in 2001 but lost relevance in subsequent years. Belgium held the top position in 2006 but fell off the top in other years. The United Kingdom ranks second in 2011, 2016, 2021, and 2022, highlighting its importance as a mediator. Another critical point is the rise of the Cayman Islands over the period, reaching the fifth position in 2022. In 2022, China and Hong Kong rank 17th and 18th, respectively, showing they still have room for improvement in their ability to mediate between other countries.

Thus, the results show that the US is the most influential country in the network,

per the measures of in-out strength and eigenvector centrality. However, the US holds less relevance according to the betweenness centrality measure, reflecting the capacity to mediate between other countries. This lesser relevance could be skewed by the rise of tax havens that channel a significant portion of financial flows originating from or destined for the US but which are registered as foreign flows in official statistics. This means many shorter paths between other countries pass through tax havens rather than the US, thus reducing its betweenness centrality. However, this does not imply that the US has lost its power and influence in the global financial network, but rather it has externalized part of its mediation through tax havens. Tax havens grow primarily in betweenness because they act as intermediaries, facilitating the flow of capital through the network. However, they cannot surpass the US in eigenvector because they lack a strong connection with other significant nodes in the network; instead, they merely channel investments. In this vein, this result is in line with Winecoff, who argued that US positions of centrality signal its hegemonic position, leaving other countries at a considerable distance. However, China's role is becoming increasingly important in the network. Despite its considerable growth in centrality, the values observed suggest that China does not currently threaten US financial hegemony.

When it comes to the dynamic analysis, the estimated nodes' fitness is represented in Figure 44. It is centered around one, a sign of the existence of "the fit get richer" mechanism in the network growth process. However, the local maximum on the right tail of the distribution shows that some node obtains a higher-than-average number of new patents recognitions as a result of its higher-than-average fitness value.

Figure 45 represents the estimated preferential attachment function. It relates the growth of new patents recognized abroad (vertical axis) to the number of existing patents countries hold (horizontal axis) for the observed period. The increasing shape, with

respect to the degree k, signals "the rich get richer." The function also presents a log-linear trend in line with the log-linear form k^α. The estimated preferential attachment exponent α equals 0.5397215, with two-sigma confidence intervals for alpha ranging from 0.4864814, 0.5929616.

Figure 44. Network's fitness distribution from 2001 to 2022.
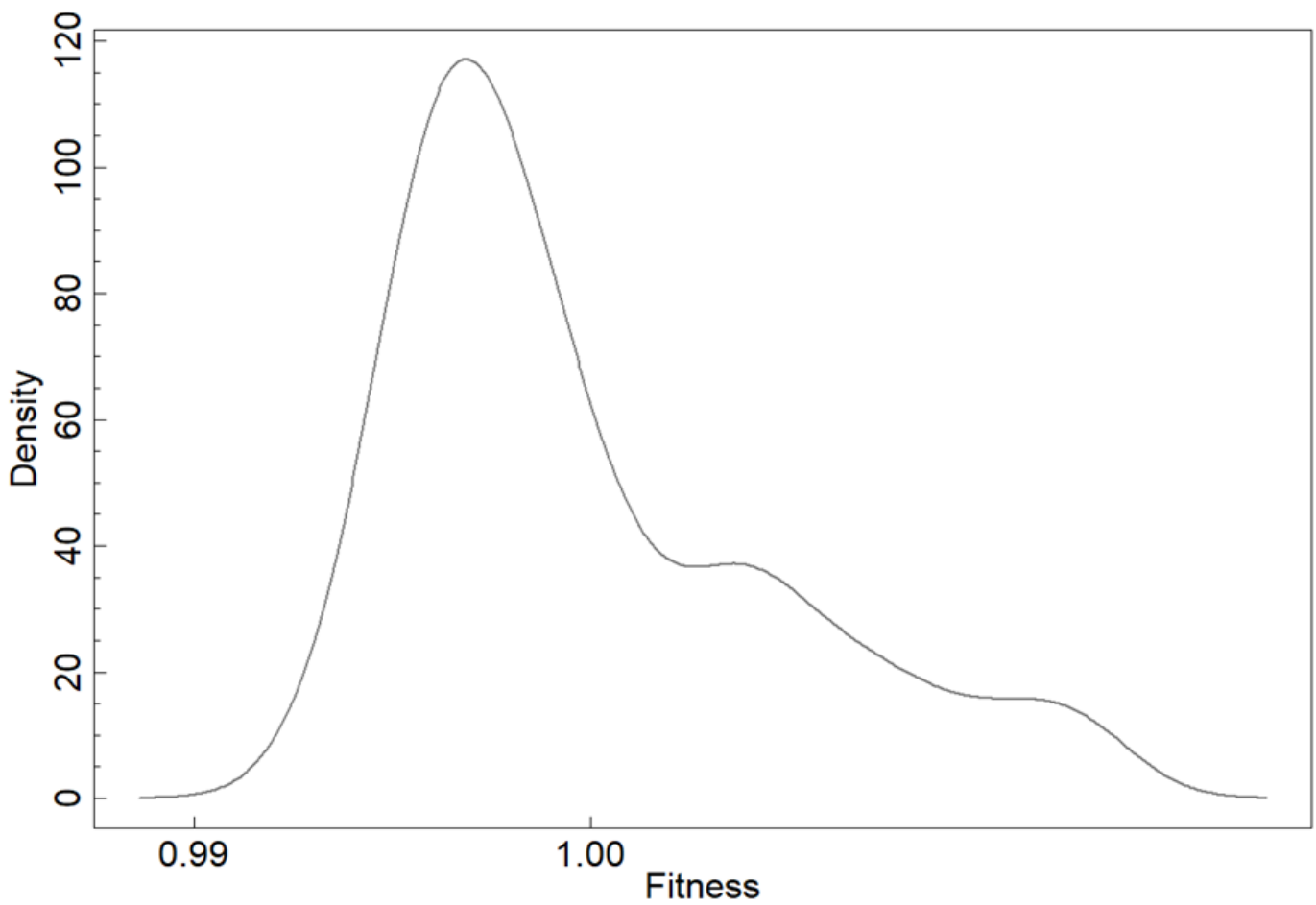
Source: IMF (2023)

Figure 45. The preferential attachment function in the financial networks from 2001 to 2022.
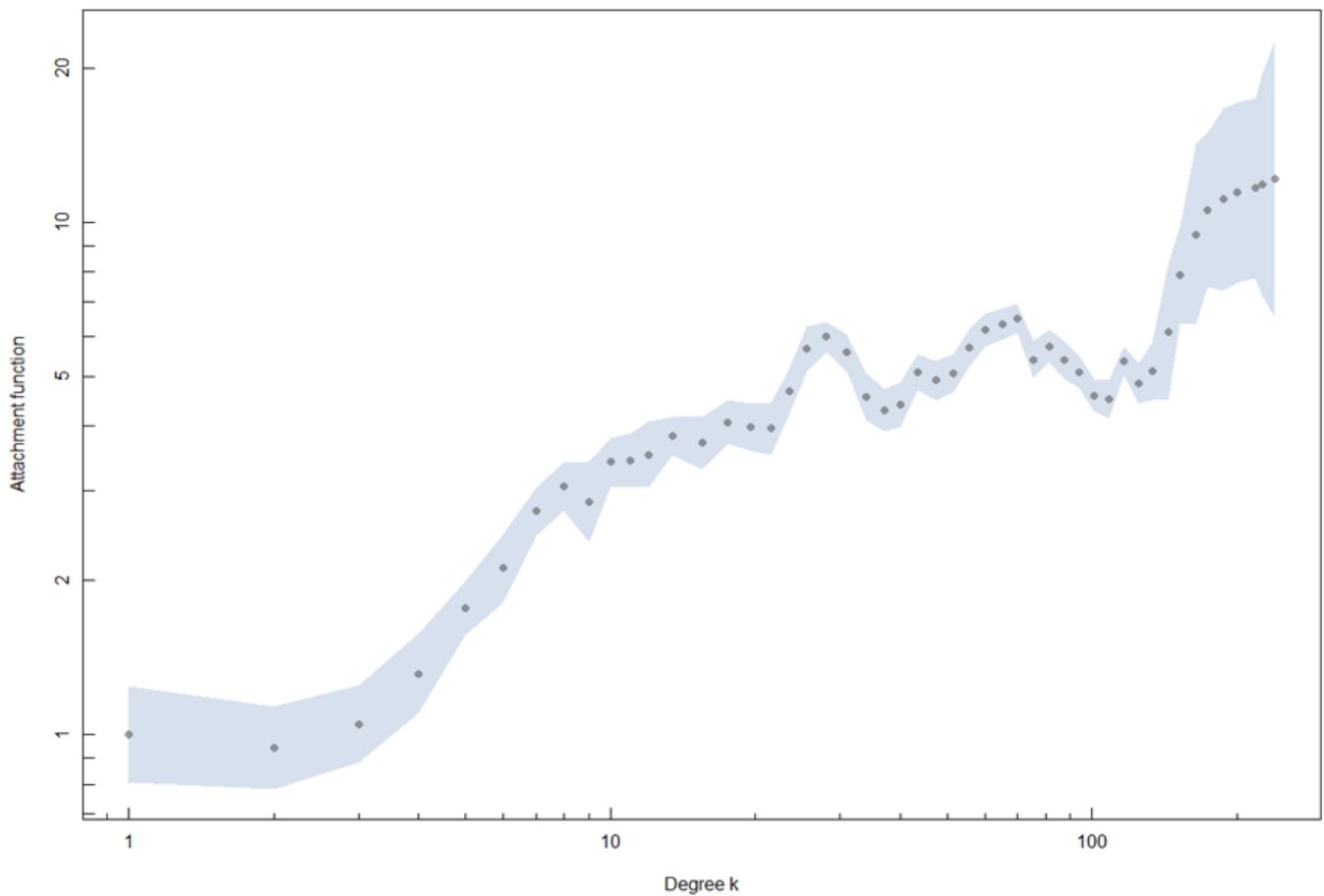
Source: IMF (2023)

Once the co-existence of the two mechanisms in the network growth is confirmed, we observe their relative weights in Figures 46 and 47. The systemic mechanisms and structural positions seem to have more weight than individual state capabilities when establishing new relations since preferential attachment has more weight than fitness in recognition of new patents: newly recognized patent is easier to obtain because of a country's (central) position in the network rather than because of its intrinsic characteristics. This result particularly interests countries aspiring to increase their international technological status. It implies that peripheral actors are unlikely to become

central, and the central actors tend to strengthen their position over time. The effort in, for example, developing a financial sector or growing intrinsic characteristics has to be extensive to overcome other countries that obtain new financial flows from their incumbent position.

These results explain why we observe few changes in the countries' ranking over time and put into perspective the extraordinary growth of China toward the core of the patent network. Indeed, the static analysis shows that China was able to climb the international ladder of financial development and become one of the central financial powers between 2001 and 2022. China's plans to change its financial system seem to affect its position in the network. However, the prevalence of the rich get richer mechanism makes the Chinese movement from the periphery to the core of the network, due to its fitness, look exceptional.

On the one hand, US financial leadership benefits from its current position at the center of the knowledge-spreading network, and this fact reinforces the status quo that could be observed in the static analysis of the in- and out-strength, as well as in the analysis of the centrality measures. On the other hand, the rise of China, based on its country characteristics, occurred against the expectation for this network. The latter casts some doubts on the persistence of the status quo.

Finally, we test the robustness of our network growth model through simulations. Figure 46 and 47 focus on the validation of both effects. In this graphical representation, we observe a consistent correspondence between our estimates and the true network data at each time step. The proximity between our estimates and the true data at each time step evidences the strength and accuracy of our model. This consistency over the simulated networks underlines the robustness of our modeling of both mechanisms, reinforcing the reliability of our estimates. Thus, the robustness of our model in reproducing the rich-get-

richer and fit-get-richer mechanisms in the growth of the global financial network is

corroborated, supporting its validity and usefulness for this type of analysis..

Figure 46. Contribution of preferential attachment to network growth
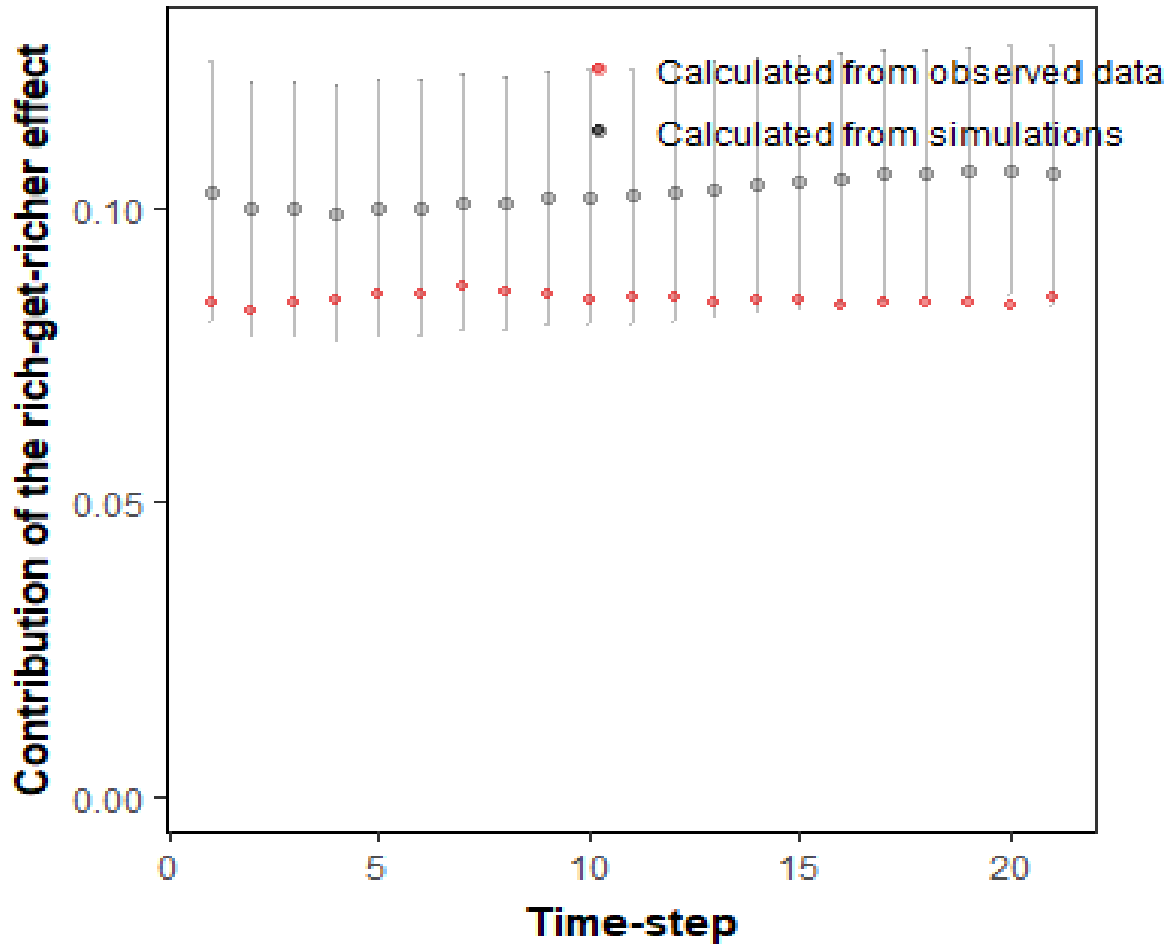
Source: IMF (2023)

Figure 47. Contribution of fitness to network growth
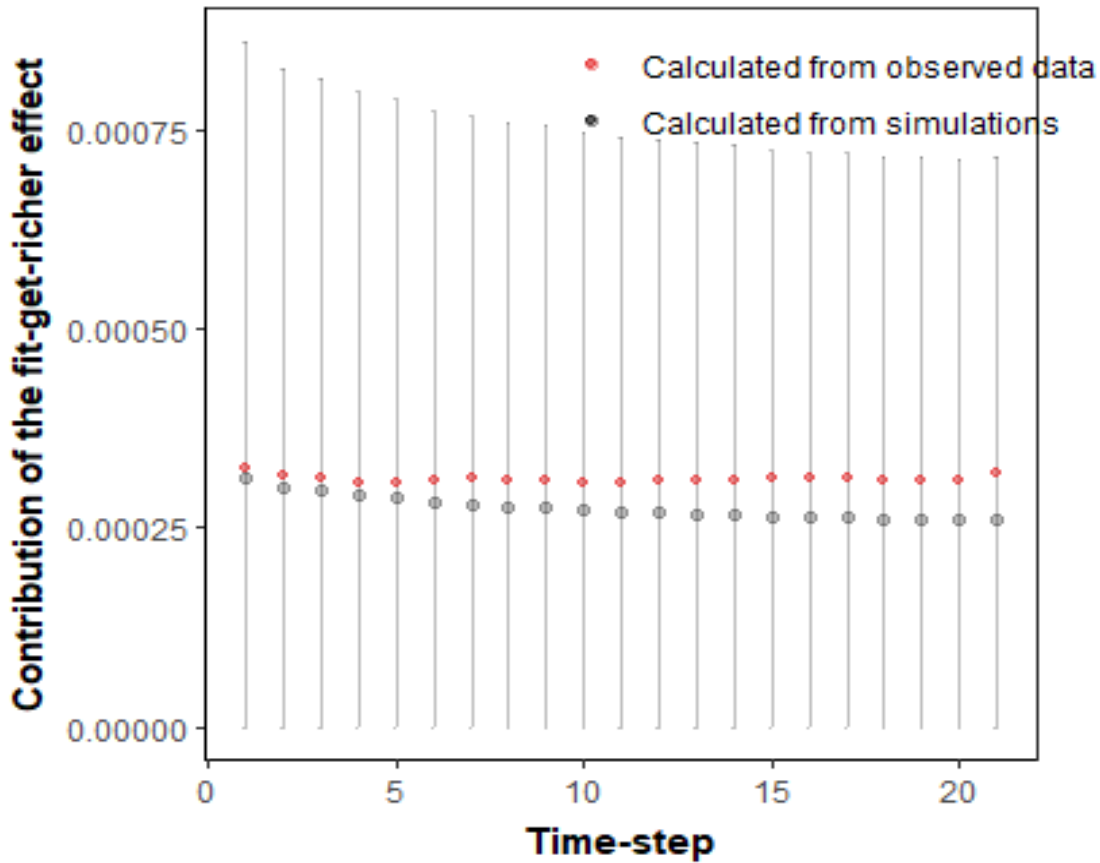
Source: IMF (2023)

6.5. Conclusions

In this Chapter, we analyzed financial hegemony from a dynamic-structural perspective, applying our methodology's second and third phases (see Chapter 2) to study the global financial network. Specifically, we studied the leadership role held by the US since the Second World War and how China is striving to augment its financial influence via mechanisms such as the BRI and the internationalization of RMB.

The results of our study provide a partial answer to several research questions posed at the beginning of this thesis. We fulfill objective 3 for the financial domain, i.e., to analyze historical and current patterns of power growth in the global system in order to determine whether power accumulation is driven primarily by a country's capabilities

("fit get richer" mechanism) or whether it is driven to a greater extent by previous structural power position in the system ("rich get richer"), which could provide clues as to the likelihood of a hegemonic transition between China and the US. Thus, we can answer research questions 2,3 and 4 of this thesis (see Chapter 1).

The findings reveal a distinct centrality of the US in terms of eigenvector centrality, accompanied by a decrease in betweenness centrality. This shift could be attributed to tax havens acting as intermediaries, facilitating capital flows throughout the network. The increased betweenness centrality of tax havens could not undermine US power or influence. On the contrary, the US could use these tax havens for financial inflows and outflows, as confirmed by its leadership in eigenvector centrality and in-out strength. Hence, in light of the results, the US has not lost its power or influence in the global financial network, but it could have merely externalized a portion of its intermediation through these tax havens. In this vein, the reduced betweenness centrality of the US could signal not a loss of power but a shift in power mechanisms.

Simultaneously, China's financial rise has propelled it to become a prominent global actor. Despite the impressive expansion of its financial sector and its newly established better position in the network, China, alongside Hong Kong, as reflected by the 2022 data, have yet to rival the influence held by the US. Moreover, the analysis of network growth mechanisms uncovers a prevailing the rich get richer phenomenon, indicating that countries with high structural power positions tend to reinforce their stance over time. Considering these results, the possibility of significant changes in the positions of influential countries could be limited, which would consolidate the hegemony of the US as it benefits from the rich get richer mechanism. In addition, China's partial financial closure and control of its exchange rate limit the RMB's ability to compete with the dollar.

In this vein, China's position in terms of structural power in the global financial

system is significantly weaker compared to the US. Moreover, the primary mechanism contributing to the growth of a country's power in the world system favors countries central to the network, in this case, the US. Thirdly, given the network growth mechanism, China would need to substantially improve its material capabilities (in general, and in particular, in this case, in the financial sector) to overcome the network growth process, which favors those better positioned. Finally, this poses a challenge for China to surpass the US. Hence, from a financial viewpoint, while China does have the potential to surpass the US as the hegemonic economic power, this is not likely to occur in the short term.

These results would partially align with (from a financial point of view) the primary hypothesis, which indicates that China's economic growth does not necessarily translate into a proportional increase in its structural power in the international system. Moreover, from the financial point of view, it reinforces the assertion of the secondary hypotheses that the growth of China's individual capabilities has not translated into a proportional increase in its structural power in the financial area and the previous leading and central position of the US in the world system in this area has been more decisive in maintaining its hegemony, despite China's improvements in its individual material capabilities.

This divergence is particularly evident in the financial sector, even more so than in the technological sector analyzed in Chapter 5. While China's individual capabilities and international projection have indeed increased, these developments have not translated into a corresponding amplification of its structural power. However, progress in the financial sphere is held back by the Chinese government's monetary and financial control. This control is linked to the country's growth model, which, as we pointed out in Chapter 3, has been closely linked to maintaining an export surplus of low-value-added goods, low consumption, and high levels of savings and investment. Therefore, it could

be deduced from this that until China manages to balance its model, as the government seeks, towards one driven by consumption, technological autonomy, and progress in GVC, it is likely that they will not push for exchange rate liberalization and relax capital controls to boost their financial power.

Thus, these findings suggest a potential incongruity between China's economic weight and its actual structural power within the international system. This discrepancy necessitates reconsidering and expanding the traditional focus that predominantly emphasizes individual material capabilities. A more comprehensive and nuanced understanding is required to decode the intricate dynamics of economic and political hegemony in the 21st century.

Therefore, while China has made significant strides in its quest to challenge US financial dominance, it still has a considerable distance to cover in the short term. Nevertheless, China's extraordinary growth and increasing influence suggest that it could potentially challenge US hegemony in the longer term.

7. CONCLUSIONS

7.1. Introduction and fulfillment of thesis objectives

Since the end of World War II, the US has had the world economic hegemon with clear leadership in critical areas such as production, technology, trade, and finance. However, China's integration into the world economy and its rapid rise to power since the 1980 shave sparked debate about a possible shift in hegemony. China has experienced significant economic growth, becoming the world's second-largest economy and increasing its global influence through initiatives such as the BRI and the AIIB.

However, problems such as overinvestment, the real estate bubble, population decline, and high inequality could threaten China's economic stability. In response, China has shifted to promoting technological progress and domestic consumption since the late 2000s. However, this change of model has had mixed success. As we have seen, over the last decade, the growth in the weight of consumption as a percentage of GDP has been timid and has even reversed between 2020 and 2022. The most significant achievements in this transformation are in the technological field. China has improved its technological autonomy, competing to develop cutting-edge technologies such as 5G and climbing positions in the GVCs.

This transformation and technological progress has intensified tensions with the US, leading to a trade and technology conflict marked by tariffs, trade restrictions, and blockades on access to critical technologies. In this vein, there is growing interest in how China's growth could lead to a shift in global hegemony, which would profoundly affect the international order and the stability of the global system.

The academic literature varies in its perspective on this question: some predict that China will be the new hegemon (Jacques, 2008; Lee, 2018; Mahbubani, 2020; Dalio, 2021). In contrast, others believe in US resilience (Winecoff, 2020; Schwartz, 2021), and some suggest a multipolar (Vlados, 2020) or bipolar system (Xuetong, 2020), or even peaceful coexistence (Arrighi, 2007). However, most analyses are theoretical, and empirical studies focus mainly on individual capabilities, such as GDP or military spending, which do not show current global power or influence.

This research has sought to assess the state of global hegemony and whether China could potentially replace the US as an economic hegemon, using a multidimensional approach that combines static-individual analysis of the material capabilities of each country in four areas (production, technology, trade, and finance), with structural-static

(the position of each country in global financial and technological structures) with dynamic-structural (the mechanisms of growth of such structures). Thus, the main objective of this thesis has been to analyze whether China can potentially replace the US as the global economic hegemon, considering various dimensions, productive, technological, commercial, and financial, and characteristics that define hegemony in the context of the current international system.

This thesis, through Chapters 2 to 6, has fulfilled the objectives outlined in Chapter 1. Chapter 2 began with an exhaustive examination of various perspectives on power and hegemony in the international arena, subsequently presenting a synthesized view that distinguishes between individual capabilities and structural approaches. The former quantifies a nation's power regarding its material capabilities, while the latter assesses a nation's power regarding its position within the structure or system. The literature review revealed a gap: while many empirical studies on hegemony have focused on individual aspects, either statically or dynamically, or structural aspects statically, dynamic-structural analyses still need to be made available.

To address this gap, we integrated both the individual and structural perspectives, formulating our first objective: to comprehensively review the existing literature to synthesize a cohesive theoretical framework relating to the concept of hegemony and to develop a methodological framework to provide an in-depth understanding of the critical dynamics and factors influencing potential hegemonic succession between China and the US and to facilitate the application of this framework at the empirical level. We accomplished this through a three-stage analysis that comprised static-individual (analysis of material capabilities), static-structural (analysis of network centrality), and dynamic-structural (analysis of network growth) elements. This innovative approach deepened our understanding of critical dynamics and factors affecting the potential

hegemonic transition between China and the US while providing a robust basis for subsequent empirical analyses.

The second objective of this thesis has been to examine in detail the characteristics and dimensions of China's rise in economic terms and compare its individual capabilities with those of the US to assess and contrast the relative weight of the two powers. We have achieved this goal in Chapters 3 and 4. Specifically, in Chapter 3, we focused on empirical analysis to thoroughly scrutinize the dimensions and characteristics of China's economic rise. In Chapter 4, we compared China and US individual capabilities through the lens of the static-individual phase. This involved examining the relative economic power of both nations across four key areas - production, trade, technology, and finance - providing an understanding of their respective standings. The results of the material capabilities show that, although the US continues to lead in most indicators, China is competing in three areas: production, trade, and technology, and still needs to catch up in finance. In addition, this analysis shows that China has managed to grow in critical points linked to disruptive technologies, such as 5G or energy transition technologies.

The third objective was to analyze the historical and contemporary dynamics of power accumulation within the global system. Specifically, it aims to assess the relative influence of a country's individual capabilities in driving power accumulation (referred to as the "fit get richer" mechanism) versus the impact of pre-existing structural power within the system (known as the "rich get richer" phenomenon). We fulfilled this objective by applying network analysis techniques to technological (Chapter 4) and financial (Chapter 5) areas. Using static-structural and dynamic-structural analysis, we evaluated the structural power of each nation and identified hegemony and network growth mechanisms. This approach facilitated examining whether power accumulation is predominantly driven by individual attributes - such as GDP, trade capacity, or

technological advancement - or by a country's previous power positions within the system. These insights have proven invaluable in assessing the potential for a hegemonic transition between China and the US.

On the one hand, the results of the implementation of phases 2 and 3 of our methodology in the technological area show a strong growth of China, which climbs to the second position, but a strengthening of US hegemony in terms of structural power. Furthermore, it shows that the technology network grows fundamentally driven by the rich get richer mechanism, which favors the strongest countries; in this case, the one who would benefit the most would be the USA. Therefore, in light of these results, China would have to compensate for this mechanism with more significant growth of its material capabilities, which could be linked to disruptive technologies, such as those linked to 5G or the energy transition. However, due to the current structural power position, as well as the growth mechanisms, the results show that it is likely that the US will continue to maintain its technological hegemony in the near future.

On the other hand, the results of applying this methodology in the financial sphere are similar. During the whole period (2001-2022), the US has a central position in eigenvector centrality (it has much power among the most powerful) but has lost positions in betweenness centrality. However, the latter could be linked to the rise of tax havens, which intermediate with the rest of the countries to connect with the US in inflows and outflows. Moreover, the growth mechanisms of the network coincide with those of the technological network: rich get richer is the primary growth driver of the network. This fact, added to the fact that China has a less central position than in the technological network, could confirm that US hegemony in the financial and technological sphere remains strong in light of the results.

By fulfilling these objectives, this research has provided a new methodology for addressing the research questions and testing the hypotheses presented in Chapter 1. Through developing a robust methodology, the detailed examination of the economic characteristics of both nations and the exploration of power growth patterns, we have deepened our understanding of the economic dynamics between China and the US on the global stage.

In the process, the research has made significant progress in overcoming limitations in the literature and offering a new perspective for analyzing shifts in global economic power. Integrating individual and structural analysis in a novel and multifaceted approach is a valuable tool for understanding the current power transition between China and the US, particularly for analyzing power in international economic relations.

The concluding sections of this thesis will present findings derived from the obtained results about the set objectives, answer the research questions, and validate the hypotheses. The analysis will focus on our understanding of China's potential to assume global hegemony and the implications such a shift might hold for the stability and future trajectory of the international system.

7.2. Overall results of the thesis, answers to questions and hypotheses

Upon fulfilling our set objectives, we now focus on the findings derived from the empirical analysis, as presented in Chapters 4, 5, and 6. In these chapters, we applied our three-fold methodological framework comprising static-individual, static-structural, and dynamic-structural analyses.

In Chapter 4, we utilized the first element of this framework: static-individual analysis. This phase was dedicated to scrutinizing China's rise and its potential as an emergent hegemonic power. We traced China's transition from a peripheral to a central economy, focusing on its economic model's evolution, strengths and weaknesses, technological capacity, and sway on the international stage. Traditionally, the Chinese economic model has been centered around trade, specifically the export of low-value-added goods, characterized by high levels of investment and modest domestic consumption. Chinese authorities have been striving for over a decade to shift this model towards one that encourages domestic consumption, higher value-added production, and technological independence. Our results indicate that while China has increased its technological autonomy and led the development of critical technologies like 5G and energy transition technologies, it remains heavily reliant on high investment levels (mainly in infrastructure and real estate). Despite incremental improvements since 2008, its domestic consumption still trails behind international benchmarks.

In comparing material capabilities with the US, the findings suggest that while China has made significant progress in production, trade, and technology, it still needs to overcome considerable obstacles in displacing the US hegemony across all dimensions. Despite impressive breakthroughs in key technology sectors such as 5G, AI, and energy transition, these advances have not yet been uniformly distributed across the Chinese economy. For instance, despite holding the world's leading exporter status, China lags behind the US regarding value-added contributions to global exports, underscoring the development gap between the two nations. Moreover, the US maintains a clear edge in the financial sector, owing to both the strength of the dollar against the yuan and the size of their respective financial markets. In addition, the internationalization of the yuan and

the rise of China's global financial power could be enhanced by avoiding capital controls and partial external convertibility of its currency.

In Chapters 5 and 6, we implemented our methodological framework's second and third parts within the technological and financial domains: static-structural and dynamic-structural analyses. In Chapter 5, we embarked on an in-depth exploration of technological hegemony, employing global patent networks as a metric for gauging a country's technological proliferation and influence on a global scale. The results highlight China's significant technological growth, transforming it from a peripheral entity to a central actor in the international patent network. Despite these achievements, the US retains its preeminent position in technological hegemony. Our analysis underscores that the US remains a critical hub within the network and has consolidated its hegemony over time. The rich-get-richer pattern observed in network growth mechanisms implies that dramatic shifts in leading countries' standings are unlikely, further bolstering US hegemony. However, China is projected to emerge as a significant player in the technological sphere, potentially serving as a systemic challenger to the US.

Chapter 6 involved applying the same methodological elements, focusing on financial hegemony through the lens of global financial networks. In light of the results, the US maintains a hegemonic position at the financial level. However, their role has evolved, and the network indicates that tax havens such as the Cayman Islands and Luxembourg play a central role in intermediating financial flows. At the same time, the US occupies a position of eigenvector centrality. This could suggest that tax havens serve as channels for financial inflows and outflows affecting the US.

On the other hand, even though China has made considerable advancements in its financial sector and now occupies a more influential position within the network, it has yet to reach the level of influence commanded by the US, remaining comparatively

peripheral. Analysis of the network's growth mechanisms shows that the predominant phenomenon is that the rich get richer, benefiting those already possessing significant structural power. This tends to reinforce positions of high structural power over time, thus further entrenching US hegemony. However, China has managed to break this mechanism in recent decades, which has allowed it to climb positions, although without overtaking the US. In this sense, countries that want to climb up the ladder must compensate for this with a significant increase in material capabilities to offset the rich get richer mechanism that benefits the central countries. This would be the case for the US and China. In short, the growth mechanism, both in terms of the technological and financial network, benefits the US over China, which could make it difficult for the Asian country to overtake the US.

This comprehensive exploration offers critical insights into the global hegemony dynamics. Although it is evident that China is making strides in key areas, based on the findings, it could be unlikely to overtake the US soon. However, various scenarios could disrupt the current dynamics.

Several scholars propose differing perspectives on the potential for power shifts. Scholars such as Arrighi (1994), Wallerstein (1984), Allison (2017), and Kai (2017) highlight that transitions in hegemony typically result in world wars when the emerging power approaches the established power.

Also, disruptive technological advances, such as those related to the Fourth Industrial Revolution or novel energy technologies, could introduce a significant shift, thus disrupting the balance of global power (Pérez & Soete, 1988; Freeman, 2007; Thompson, 2020; Rikap & Lundvall, 2021).

Based on the results of the analysis, the answers to the research questions can be outlined as follows:

1. To what extent has China managed to catch up or surpass the US regarding individual capabilities in the productive, technological, commercial, and financial spheres?

China has made substantial advancements in production, technology, trade, and finance, facilitating its emergence as a strong competitor to the US.

In terms of production, China has successfully surpassed the US in GDP PPP (but not in constant GDP terms), the value added in the global industrial sector, and the number of global trademarks and industrial designs, thus reflecting the robustness of the Chinese economy. However, this growth is predominantly extensive rather than intensive: the US maintains its GDP per capita and productivity superiority. Furthermore, the US is home to most of the world's top companies. In this line, the results show an increasing rapprochement between China and the US, although, generally, the US continues to lead in the productive area. However, the trend could point to a future overtaking in the future.

In the technological domain, China has outpaced the US regarding value added in KTI industries and the total number of patents. Despite this, the US remains at the forefront of KTI services, value added in high R&D-intensive industries, international patents, charges for intellectual property, and human capital. In addition, China either leads or competes at a similar level in disruptive technologies, such as 5G, AI, and those associated with new energy sources. Therefore, the technological results show a similar line to the productive ones: generally, the US continues to lead, mainly internationally, but China competes in specific technologies that can potentially be disruptive.

From a trade perspective, China has become the world's largest goods exporter, but the US continues to lead in the services sector. However, the US is still substantially ahead when we examine the value added in final exports worldwide. This underscores China's productive, technological, and commercial growth is more extensive than intensive, and the technological momentum is not evenly distributed throughout the economy. Leadership in disruptive technologies may signal significant shifts in the global power structure, implying that advancements in technologies like 5G or those related to new energy sources could represent a qualitative or disruptive leap forward.

In the financial and monetary sector, the US retains its dominance, both in the size of its markets and the role of the dollar. The yuan remains a long way from becoming a crucial currency in the global system, mainly due to the limitations of the Chinese model that retains capital controls and exchange rate regulation.

In conclusion, in light of the results, despite the rise of China, especially at the extensive level, the US remains a more efficient power in production, trade, and technology. Financially, there is still no rivalry. However, China's advances in critical technologies may instigate a disruptive change in the global power structure.

2. What is the relative position of China and the US regarding structural power in the world system?

The results show that China's structural power within the global system has transformed from a peripheral role to a central one, particularly in the technological sphere. This transformation is evidenced by China's position within the international patent network. However, in light of the results, the US maintains a dominant position, signifying a superior structural power in technological and financial networks. While

China has emerged as a significant international force, thus heightening its rivalry with the US for global hegemony, it remains less central than the US.

3. What are the main mechanisms and factors that contribute to the growth of a country's power in the world system, and how can these mechanisms help explain the dynamics of the possible hegemonic transition between China and the US?

The "rich-get-richer" pattern is a primary mechanism that contributes to a country's power growth in the global system. This could suggest that nations with considerable power tend to reinforce their positions over time in technology and finance. Given the hegemony and centrality of the US, such a mechanism fortifies its dominance. China would need to augment its material capabilities sufficiently to counterbalance the network trend favoring nations with more structural power. China has made some progress in this regard, particularly regarding technological power, but it has not yet surpassed the US.

4. Considering the mechanisms and factors identified in the previous question, what conditions and future scenarios could China overtake the US as a hegemonic power?

In light of the results, potential scenarios that could facilitate China's overtaking of the US as a hegemonic power would likely necessitate China's continuous enhancement of its individual capabilities at a rate sufficient to counterbalance the structural mechanisms that favor the US (rich get richer). The achievement of such progress would necessitate an extension of the advancements made in recent years. However, this endeavor appears challenging due to the anticipated growth rate deceleration in the forthcoming years and the complexities associated with transitioning China's production model towards a greater emphasis on domestic consumption and

technological development. Within this context, a transformation in which technological development assumes a central role could be critical. Additionally, as previously mentioned, the advent of the fourth industrial revolution could present an opportunity for a hegemonic shift if China manages to lead in pioneering disruptive technologies. Moreover, if the ongoing technological and trade conflicts escalate into a conventional military confrontation, a change in hegemony could be accelerated.

5. Considering the multiple dimensions comprising hegemony, does China have the potential to surpass the US as the leading economic power?

The analysis of China's individual capabilities suggests that it has the potential to surpass the US as a hegemonic economic power in the future, notwithstanding the evident gap in the financial sphere. However, China's structural power has not proportionately increased, as evidenced by technological and financial structural power analysis. Furthermore, dynamic-structural analysis has shown that technological and financial power is contingent upon prior structural power – one's position in the network rather than material capabilities. This presents a challenge for China, which has faced hurdles in amplifying its structural power, and the mechanism currently favors the existing hegemon. Thus, based on the results of the three levels of analysis, China is not currently positioned to overtake the US in the short to medium term.

However, given its steady economic growth, technological advances, and influence in international trade, it is not implausible that China will pose a significant challenge to the US hegemony in the future if technological disruptions or some form of military conflict should arise. Future research would benefit from exploring the strategic maneuvers China might undertake to increase its structural power and the potential implications of such a rise for the global economic and political order.

The main hypothesis of this thesis is that *China's GDP or trade weight growth does not necessarily translate into a proportional increase in its structural power in the international system. Despite significant advances in critical areas such as technological development, China is still far from reaching or surpassing the hegemonic position of the US.* The results in Chapters 4, 5, and 6 align with the thesis's central hypothesis, for despite substantial individual capabilities progress, China is still a considerable distance away from reaching the structural power and hegemonic position held by the US in technology and finance.

Regarding the first secondary hypothesis, the empirical analyses support the proposition that China's growth in individual capabilities has not resulted in a proportional increase in structural power in critical areas such as technology and finance. Despite China's impressive growth in production, trade, and technological advancements, it still lags behind the US regarding global structural power in finance and technology. This phenomenon is clearly illustrated in technology, where, despite China's progress, the US maintains a stronger position within the global patent network, underscoring its sustained hegemony.

The second secondary hypothesis seems to be confirmed in light of the research results. As reflected in global technological and financial networks, structural power indicates that the US' former centrality in the world system is more influential in maintaining its hegemony. These findings suggest that, despite China's substantial improvements in its individual material capabilities, the inertia of structural power largely favors those who already occupy a position of hegemony, thus reinforcing the current dominant status of the US.

Thus, the hypotheses presented at this thesis' beginning align with the empirical analysis' findings. The study's results underscore the crucial distinction between

individual capabilities and structural power in understanding hegemony. This distinction offers an important perspective for interpreting the dynamics of hegemonic transition that overcomes empirical studies on hegemony focus on individual aspects statically (Brooks & Wohlforth, 2016; Beckley, 2018), individual aspects dynamically (Modelski, 1987; Grinin & Korotayev, 2010, 2015), and structural aspects statically (Winecoff, 2020). Thus, a rich field for future research is offered. Future work could focus on investigating how countries such as China can bridge the gap between their growing individual capabilities and their structural power in the international system.

7.3.   The New Balance of Global Power: A Hybrid System

Reflecting on the global landscape that has unfolded since the conclusion of the Cold War, we no longer inhabit the same unipolar world that the US-led from the 1990s onwards. Global power dynamics have undergone significant shifts in recent decades. However, these changes do not necessarily denote a transition into a simple bipolar or multipolar system, as US hegemony endures amidst these transformations.

The ascent of China provides a compelling counterweight to US hegemony, introducing an alternative dynamic that reshapes international power relations. China's burgeoning prominence, particularly in productive, technological, and commercial domains, notably challenges the unipolarity that typified the post-Cold War era.

However, while China's growth undeniably influences the international system, it does not represent a complete transition into a bipolar or multipolar world. This assertion is underpinned by the nuanced understanding that hegemony extends beyond individual capabilities and requires consideration of structural power within international networks. This study illustrates that, despite China's considerable individual capabilities, it has not achieved an equivalent increase in structural power.

Furthermore, the persistence of US structural power within crucial networks, particularly those associated with technology and finance, continually fortifies its hegemonic status. The current global context thus bears features of a hybrid system, wherein the dominance of the US coexists with China's increasing influence, engendering a unique balance of power. This novel dynamic offers alternative options to US power for nations and corporations worldwide, potentially leading to more advantageous negotiations in international agreements.

Given Farrell and Newman's (2019) argument that interdependencies among nations extend beyond mere instruments of exchange and mutual benefit and are progressively evolving into instruments of global competition, the findings of this research hold significant relevance. Examining structural power within international networks undertaken in this study sheds light on these dynamics. It underscores the strategies that major powers such as the US, China, and the EU use to leverage their positions in global networks to attain strategic advantages.

Moreover, our findings confirm the arguments of Starrs (2013, 2018), Schwartz (2019, 2021), and Winecoff (2020), who asserted a resilient US hegemony. However, the findings are also consistent with those of Malkin (2020) and Rikap and Lundvall (2021), who noted that China's participation in GVC and the global intangible economy has the potential to increase its influence on the global economy significantly. China's technological growth has transformed it into a major power, which means that the US has a new counter-power, although this does not imply that it will change hegemonic power.

As globalization enters an era of strategic decoupling or de-risking, nations seek to reconfigure GVC to minimize their vulnerabilities. In this changing landscape, understanding the structure of international networks is critical to deciphering global power dynamics. Nations strategically positioned within these networks can exert

significant influence, potentially weaponizing interdependence to achieve geopolitical objectives. This study provides a critical analytical lens based on network theory to better understand these complex dynamics. Given the current context, the thesis results could mean increased tensions and the use of trade as a weapon as China continues gaining weight in global economic networks.

However, the weaponization of trade, technology, or finance and the ongoing competition between world powers pose significant challenges in addressing global crises that require international cooperation. Climate change represents a crisis that requires collective action and the pooling of technological advances to devise sustainable solutions. The current tension between economic and geopolitical competition, manifesting itself in technological and trade wars, and the need for cooperation to address climate change poses a formidable challenge to global leadership.

Consequently, the nuanced understanding of economic hegemony this study presents, encompassing material capabilities and structural power within international networks, is of substantial relevance. This insight can guide the formulation of policies and strategies in this intricate and rapidly evolving global landscape, delicately balancing national strategic interests with the pressing global need for collaboration to confront shared challenges.

7.4. Limitations and additional avenues of research

This doctoral thesis makes multifaceted contributions to both the field of IPE and IR and the broader study of global hegemony, with several implications:

First, the study presents a holistic understanding of economic hegemony by examining individual capabilities and structural power within the world system. This holistic perspective fills a gap in the literature that often prioritizes singular aspects of

economic power, thus providing a nuanced understanding of the complexities and interdependencies within the global economic system.

Second, the study provides a robust empirical analysis of the potential hegemonic transition from the US to China. It illuminates the dynamics of this potential transition through a detailed examination of each nation's positions within the global patent network and financial network, providing tangible evidence that can inform future research and policymaking.

Third, this research contributes significantly to understanding the relationship between a country's individual capabilities and its structural power. Despite China's impressive economic growth and the development of its capabilities, the study reveals that China has not achieved a commensurate increase in its structural power. This is crucial for guiding future research and policymaking.

Finally, the findings of this thesis offer valuable insights that can inform the economic and political strategies of the US, China, and other nations observing global power dynamics. Recognizing the continued hegemony of the US in critical sectors, despite China's substantial gains, as well as China's challenges in enhancing its structural power, can influence policy decisions in trade, technological development, and financial internationalization.

However, while the study provides a comprehensive view of the changing dynamics of economic hegemony between the US and China, it is vital to recognize its inherent limitations. The assessment of individual and structural capabilities relies primarily on measurable material indicators, potentially overlooking less tangible but crucial factors contributing to a nation's international influence. This reliance on historical data in projecting future trends and patterns presupposes continuity in existing economic, political, and technological conditions. This limitation can bias expected outcomes in the

face of unexpected events. Moreover, the aspects analyzed are confined to the economic area, particularly in technology and finance, while there are fundamental factors in hegemony, such as military or cultural power.

The study suggests several avenues for further research in light of these limitations. The study of other types of networks similar to technological or financial networks, such as trade or other more focused sub-networks, may complement the study of power at the global level. In addition, investigating the mechanisms of network growth and how emerging powers can navigate these structures or disrupt them could offer valuable insights.

Beyond the academic realm, the findings of this study have important implications for policymaking. As China continues its rise as a global power, its relationship with the United States and the international community will remain a focus. Understanding the multifaceted nature of hegemony is critical to effective and forward-looking policymaking.

In conclusion, while the study sheds light on the complex dynamics of hegemonic transition in a rapidly changing global landscape, it also raises other questions that epitomize academic research's nature.

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