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The Analysis of Cultural Convergence and Maritime Trade Between China and Saudi Arabia: Toda–Yamamoto Granger Causality

Nashwa Mostafa Ali Mohamed ¹, Jawaher Binsuwadan ^{2,*} , Rania Hassan Mohammed Abdelkhalek ³ and Kamilia Abd-Elhaleem Ahmed Frega ⁴ 

¹ Department of Economics, College of Business Administration, King Saud University, P.O. Box 173, Riyadh 11942, Saudi Arabia; nmohamed@ksu.edu.sa

² Department of Economics, College of Business Administration, Princess Nourah Bint Abdulrahman University, P.O. Box 84428, Riyadh 11671, Saudi Arabia

³ Department of Quantitative Analysis, College of Business Administration, King Saud University, P.O. Box 173, Riyadh 11942, Saudi Arabia; rabdelkhalek.c@ksu.edu.sa

⁴ Department of Economics, College of Business, Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh 11564, Saudi Arabia; kamilia.ahmed@commerce.helwan.edu.eg

* Correspondence: jabinswaidan@pnu.edu.sa

Abstract

This study investigates the dynamic relationship between maritime trade and cultural convergence between China and Saudi Arabia, with a particular focus on the roles of creative goods and information and communication technology (ICT) exports as proxies for sociocultural integration. Utilizing quarterly data from 2012 to 2021, the analysis employs the Toda–Yamamoto Granger causality approach within a Vector Autoregression (VAR) framework. This methodology offers a robust means of testing causality without requiring data stationarity or cointegration, thereby reducing estimation bias and enhancing applicability to real-world economic data. The empirical model examines causal interactions among maritime trade, creative goods exports, ICT exports, and population, the latter serving as a control variable to account for demographic scale effects on trade dynamics. The results indicate statistically significant bidirectional causality between maritime trade and both creative goods and ICT exports, suggesting a reciprocal reinforcement between trade and cultural–technological exchange. In contrast, the relationship between maritime trade and population is found to be unidirectional. These findings underscore the strategic importance of cultural and technological flows in shaping maritime trade patterns. Furthermore, the study contextualizes its results within broader policy initiatives, notably China’s Belt and Road Initiative and Saudi Arabia’s Vision 2030, both of which aim to promote mutual economic diversification and regional integration. The study contributes to the literature on international trade and cultural economics by demonstrating how cultural convergence can serve as a catalyst for strengthening bilateral trade relations. Policy implications include the promotion of cultural and technological collaboration, investment in maritime infrastructure, and the incorporation of cultural dimensions into trade policy formulation.



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1. Introduction

Cultural convergence is “the process by which two or more cultures begin to blend together, resulting in the sharing of values, beliefs, customs, and behaviour” [1]. Cultural exchanges and improved connections between people have significantly strengthened the economic ties between China and Saudi Arabia. From 2011 to 2016, there was a 50% increase in the number of Chinese citizens working. Additionally, over 1000 Saudi students pursued their education in China annually during this period. This exchange of human capital has been mutually beneficial for the economies of both countries. Looking ahead, an increase in tourist flow from China to Saudi Arabia could further boost the Saudi economy.

China and Saudi Arabia have a long history of cultural exchange, dating back to the ancient Silk Road and the maritime spice road. Convergence theory supports that the more interaction two countries have with each other, the higher the potential that their similarities or shared interests will increase. Since 1990, China and Saudi Arabia have established their diplomatic relations across multiple sectors, including trade and culture. Between 2000 and 2020, maritime trade between the two nations increased by approximately 250%, making China Saudi Arabia’s second-largest trading partner by 2020 [2]. This surge in trade relations was accompanied by a noticeable cultural convergence, evident in areas such as the arts, cuisine, and tourism. Both nations witnessed a 60% increase in mutual tourism and the establishment of several bi-national cultural festivals during this period [3]. Also, the enhanced trade relations foster understanding and appreciation of the other’s culture [4]. Additionally, trade reduces cultural distance according to Blouin and Dyer [5], but only when trade partners share some culture-related traits [6]. However, several challenges may impact this relationship, such as the geopolitical tensions in the Middle East, and the environmental concerns related to the demand for oil.

This study adopts a quantitative approach to investigate the evolving relationship between China and Saudi Arabia, focusing on the intersection of maritime trade and cultural convergence. Utilizing quarterly data from 2012 to 2021, the analysis encompasses the period marked by the global COVID-19 pandemic, which significantly disrupted international trade and sociocultural exchange. The deliberate inclusion of data from 2020 and 2021 enables the capture of structural shifts and adaptive responses in bilateral trade dynamics during times of crisis. Omitting these years would risk overlooking critical transformations in trade patterns, the expansion of digital export channels, and population-driven demand—factors that have become increasingly salient in the post-pandemic global economy. To ensure methodological rigor, the study employs the Toda–Yamamoto extension of the Granger causality framework within a Vector Autoregression (VAR) model. This approach is particularly well-suited for real-world economic analysis, as it allows for the testing of directional relationships among variables without the prerequisite of stationarity or cointegration. By circumventing traditional pre-tests, such as unit root and cointegration diagnostics—which are prone to introduce estimation bias—this method mitigates the risk of distorted causal inference, particularly in the presence of structural breaks like those induced by the pandemic.

Despite the existing literature on maritime trade and cultural exchange, there is a notable gap in understanding how cultural factors shape trade outcomes between China and Saudi Arabia. Most studies focus on economic or infrastructural variables, often overlooking the influence of cultural convergence, especially through creative exports and ICT flows. Additionally, traditional econometric models typically rely on restrictive assumptions such as stationarity and cointegration, which limit their applicability to real-world, time series data impacted by structural shifts. In response, this study employs the Toda–Yamamoto Granger causality framework to investigate these dynamics without imposing such limitations. The analysis focuses on Maritime Trade (MT) as the dependent

variable and includes Creative Goods Exports (CRE), ICT exports, and Population (POP) as explanatory variables. These variables are chosen to capture the multifaceted nature of economic, cultural, and demographic interactions between the two countries.

The results reveal significant bidirectional causality between maritime trade and both creative goods and ICT exports, emphasizing the role of cultural and technological integration in strengthening bilateral trade ties. Meanwhile, the unidirectional relationship from population to trade highlights demographic influence on trade volume without reciprocal effects. These findings advance scholarly understanding by revealing how cultural convergence complements economic exchange. They also inform policy by identifying strategic areas—such as digital and creative sectors—for enhancing maritime trade cooperation. Ultimately, this study contributes a nuanced and empirically grounded perspective to the broader discourse on China–Saudi Arabia relations, offering practical insights for policymakers and stakeholders aiming to foster sustainable and culturally informed trade partnerships.

The remainder of this paper is structured as follows: Section 2 provides a literature review on the evolution of China–Saudi Arabia relations, highlighting previous research on trade and cultural exchange. Section 3 outlines the China–Saudi trade relationships, while Section 4 introduced the cultural convergence dimensions. Section 5 presents methodology, including data sources and the econometric model used, particularly the Toda–Yamamoto Granger causality approach. Section 6 presents the empirical results and discusses the implications of these findings, examining opportunities and challenges within the bilateral relationship. Finally, Section 7 concludes the paper with policy recommendations and suggestions for future research.

2. Literature Review

Convergence theory, originally introduced by Kerr et al. [7], suggests that as societies engage more—through industrialization, trade, and communication—they gradually become more alike in institutional structures, cultural practices, and economic systems. While initially used to describe the convergence of capitalist and socialist models, the theory has since been applied to international relations and cultural exchange. Within this framework, increased interaction between nations fosters shared values and mutual understanding—trends increasingly visible in the China–Saudi Arabia relationship.

According to competitive advantage theory, culture significantly enhances firms' competitiveness in global markets. Nevertheless, the interplay between trade and culture remains contentious, particularly for nations advocating the liberalization of cultural trade. While cultural elements—such as distinctive products and brands—can explain and strengthen competitive advantages in international commerce, they simultaneously function as market access barriers. Opening domestic markets to culturally resonant imports (e.g., films and music) is frequently perceived as endangering local cultural identities [8,9].

The literature presents a multifaceted view of the nuanced interplay between cultural convergence and maritime trade, particularly in the context of China and Saudi Arabia, but it leaves certain areas relatively unexplored. The necessity and challenges of sustainable development in maritime strategies, as encapsulated by the Maritime Silk Road initiative, emphasize the importance of environmental and cooperative considerations in maritime expansions [10]. This discussion sets a precedent for examining the role of such initiatives in fostering bilateral relations, yet the specific dynamics of cultural and trade exchanges between China and Saudi Arabia remain less addressed.

Historical and cultural interactions facilitated by maritime routes, as seen in the Baba-Nyonya culture's formation and the traditional shipbuilding practices in Cyprus, shed light on the transformative potential of maritime connectivity for cultural integration [11,12].

These examples illustrate the capacity of maritime trade to blend cultures, offering a perspective that could enrich the understanding of China–Saudi Arabia relations. However, the direct relevance of these historical and cultural insights to the contemporary maritime trade and cultural exchanges between these two nations is not fully explored, indicating a gap in the literature.

The examination of economic trends and technological advancements in maritime trade offers insights into the economic frameworks and infrastructural developments supporting maritime activities [13,14]. These studies provide a backdrop against which the economic and infrastructural aspects of China–Saudi Arabia’s maritime trade could be analyzed. Nonetheless, the specificity of these bilateral trade relations, including the infrastructural and logistical nuances, is not adequately addressed, revealing a gap for more targeted investigation. Infrastructure quality significantly affects trade performance, especially in African countries, highlighting the broader importance of efficient port and telecommunications infrastructure for enhancing bilateral trade [15,16]. While this research underlines the critical role of infrastructure investment, its direct applicability to the unique infrastructural and logistical contexts of China–Saudi Arabia trade necessitates further exploration.

Cultural exchanges’ impact on trade dynamics, as evidenced by the influence of Confucius Institutes and linguistic convergence, suggests mechanisms through which cultural factors could enhance bilateral trade [3,17]. However, the exploration of these mechanisms in the specific context of China–Saudi Arabia trade and cultural relations is not thoroughly developed, presenting a framework that requires adaptation to this unique bilateral context. Moreover, the direct examination of trade dynamics and cultural convergence, particularly in the energy sector’s context between China and Saudi Arabia, offers relevant insights, yet often focuses on economic indicators without fully incorporating cultural dimensions [18]. This approach underscores the economic underpinnings of the relationship but also points to the need for a more integrated analysis that considers how cultural aspects influence and are influenced by economic exchanges.

Furthermore, Mornah and MacDermott [9] note that differences in some international cultural dimensions have the potential to impact the competitiveness of bilateral international trade. Additionally, Gouvea and Vora [19] also point to the role of exports of creative goods and services in economic development, noting that knowledge-based economies with large ICT sectors are better able to achieve a competitive advantage and significant gains from the export of creative services. On the other hand, Lorde et al. [20] emphasize that cultural industries significantly contribute to societal well-being and economic development. They argue that the formulation of cultural policies at the national or regional level can foster an enabling environment for cultural production, thereby encouraging individuals and cooperatives to enhance the creation of cultural goods for export. Furthermore, they advocate for diversification in export markets, noting that although the Caribbean’s strongest export potential lies with culturally proximate countries, opportunities also exist in culturally distant markets, which could yield substantial benefits. Additionally, Xu et al. [21] point out that the Maritime Silk Road Initiative has contributed to the strengthening of China’s maritime trade, and that the cultural distance effect is U-shaped with China’s total trade and exports of forest products. This means that as cultural distance increases, China’s trade and exports of forest products have a trend of first decreasing and then increasing.

Liu et al. [22] contend that cultural exchanges promoted by the Belt and Road Initiative (BRI) have a more profound impact on increasing trade flows and strengthening bilateral cooperation than institutional distance. These findings are consistent with a study by Li, Han, Li, Wei, and Zhang [17], where the smaller the cultural distance, the stronger the

promotional effects on trade in Belt and Road countries. Chen et al. [23] also discussed the development of cultural trade networks in the Belt and Road region and their impact on global cultural sustainability. The study confirmed that cultural trade networks have enhanced the integration of cultural diversity within the region and the global market. In contrast, a study by Yeganeh [24] on the effects of cultural, religious, and linguistic differences on bilateral trade confirmed that differences in culture and religiosity can promote international trade, while linguistic diversity hinders trade. This contradicts the study by Wang et al. [25], where shared language and religious beliefs enhance the positive effects of trade liberalization.

In sum, while the reviewed literature collectively touches upon various dimensions relevant to maritime trade and cultural exchange as seen in Table 1, a cohesive and in-depth examination specifically tailored to the China–Saudi Arabia context remains lacking. This gap identifies a critical area for future research, calling for an approach that integrates sustainable maritime strategies, historical and cultural influences, economic and infrastructural underpinnings, and the potential of cultural exchanges to deepen and enrich bilateral trade relationships. In the next section, we will conduct a detailed examination of relevant studies to shed light on the relationship between international trade and culture.

Table 1. Summary of previous studies examining the relationship between international trade and culture.

Author (s)	Purpose	Methodology	Findings
Wang. et al. [25]	Examine impact of trade liberalization on China–ASEAN trade under BRI. Analyzed moderating effects of cultural factors (language/religion).	Augmented Gravity Model framework. Analysis of international panel data (2012–2022) China–ASEAN nations.	Increased trade liberalization significantly enhances bilateral trade volumes between China and ASEAN. Shared language and religious beliefs amplify the positive effects of trade liberalization.
Liu et al. [22]	Examine the roles of cultural distance and institutional distance in China’s trade relationship with the Belt and Road (B&R) countries	Gravity model using bilateral trade data at product-level during 2002–2016 between China and 99 trading partners.	Cultural distance and institutional distance inhibit China’s bilateral trade with the Belt and Road and cultural exchange driven by the BRI eventually assisting unimpeded trade and deepening the cooperation
Chen et al. [23]	Does the cultural trade network contribute to the integration of cultural diversity into the global market?	A social network analysis methodology to analyze the cultural trade network and its temporal evolution among 66 countries in the Belt and Road region between 1990 and 2016	The cultural trade network has promoted the integration of cultural diversity into the global market
Yeganeh [24]	The effects of cultural, religious, and linguistic differences on bilateral trade	Gravity model, using trade data for over 50 countries	Linguistic diversity hinders trade. But some differences in culture and religiosity can enhance international trade.

Table 1. Cont.

Author (s)	Purpose	Methodology	Findings
Mornah and MacDermott [9]	Which cultural aspects have a significant influence on bilateral trade performance or competitiveness?	Gravity model on trade data covering 59 countries and 29 years combined with the nine (GLOBE) culture dimensions, Population, GDP	Certain aspects of culture enhance bilateral trade performance/competitiveness. Performance Orientation, Future Orientation, Institutional Collectivism, Gender Egalitarianism, Power Distance and Uncertainty Avoidance improve bilateral trade performance while Assertiveness, Humane Orientation and In-Group Collectivism impair it.
Li, Han, Li, Wei, and Zhang [17]	The impact of cultural exchanges through Confucius Institutes on regional trade cooperation from three dimensions: improving cultural identity, reducing trade costs and sharing information	Gravity model and used trade data from the 64 countries along the line from 2004 to 2015	The smaller the cultural distance, the stronger the promoting effects on the trade in BRI countries.
Xu et al. [21]	Examine the impact of the 21st Century Maritime Silk Road (CMSR) initiative and cultural distance on China's forest product trade.	Used DID method based on quasi-natural experiments to evaluate the policy effects of the CMSR Initiative on forest product trade. Panel data on forest product trade between China and 78 countries from 1995 to 2017	Cultural distance has a U-shaped relationship with China's total forest product trade and exports. This means that as cultural distance increases, China's forest product trade and exports show a trend of first decreasing and then increasing.

3. China–Saudi Arabia Trade Relationships: An Overview

The trade relationship between China and Saudi Arabia has evolved from one of marginal importance to a comprehensive strategic partnership, largely due to the growth of trade between the two countries. Since establishing formal ties in July 1990, China and Saudi Arabia have flourished, particularly after declaring a strategic friendly relationship in 2008. In 1990, the trade volume was \$417 million, which has now grown to nearly \$73 billion in 2019 [25]. Economic engagements, including high-level visits, strategic agreements in the energy sector, and trade memoranda, have propelled China to become a key trade partner with Saudi Arabia, overtaking the U.S. More recently, in 2016 and 2022, comprehensive strategic partnerships were forged, enhancing bilateral ties further, with ongoing talks for a Free Trade Agreement under the auspices of the Gulf Cooperation Council [26]. Negotiations for a Free Trade Agreement between China and the Gulf Cooperation Council initiated in 2004, have recently regained traction, particularly with the encouragement of Saudi Arabia. This renewed interest is part of broader efforts by Gulf nations, notably Saudi Arabia and the UAE, to diversify their economies beyond oil, focusing on industries like manufacturing, technology, and mining. The GCC is keen on expanding into various sectors to ensure economic growth and sustainability.

The Belt and Road Initiative (BRI), introduced by President Xi Jinping in 2013 and officially outlined in 2015, represents China's strategic approach to global partnerships and economic development, impacting international relations, especially with nations along the BRI corridors. The initiative is a central element in China's foreign policy and economic strategy, aiming to enhance regional cooperation and connect various markets through a network reminiscent of the ancient Silk Road. Saudi Arabia is a strategic partner of China in the BRI, as it is located at the crossroads of the Red Sea and the Persian Gulf, and has access to the Suez Canal, a vital waterway for global trade [27]. According to UNCTAD statistics in 2022, China is the largest trade partner of Saudi Arabia, receiving exports worth \$76.197 billion from Saudi Arabia. On the other hand, Saudi Arabia is not one of the top five partners of China. This relationship underscores a degree of economic dependency on China's demand for Saudi exports. Economic fluctuations, policy changes, or shifts in demand within China could have a significant impact on Saudi Arabia's economy [28].

In 2021, as illustrated in Figure 1, Saudi Arabia's exports to China amounted to \$48.7 billion. The primary exports included crude petroleum (\$38.3 billion), ethylene polymers (\$2.19 billion), and acyclic alcohol (\$1.81 billion). Over a span of 26 years, from 1995 to 2021, Saudi Arabia's exports to China have surged, growing at an annual rate of 20.4% from \$392 million to \$48.7 billion. From China's perspective, in 2021, it exported goods worth \$29 billion to Saudi Arabia. Key exports comprised broadcasting equipment (\$2.07 billion), automobiles (\$1.68 billion), and lighting fixtures (\$1.1 billion). Over the same 26-year period, China's exports to Saudi Arabia witnessed a significant increase at an annual growth rate of 14.3%, escalating from \$904 million in 1995 to \$29 billion in 2021 [29].

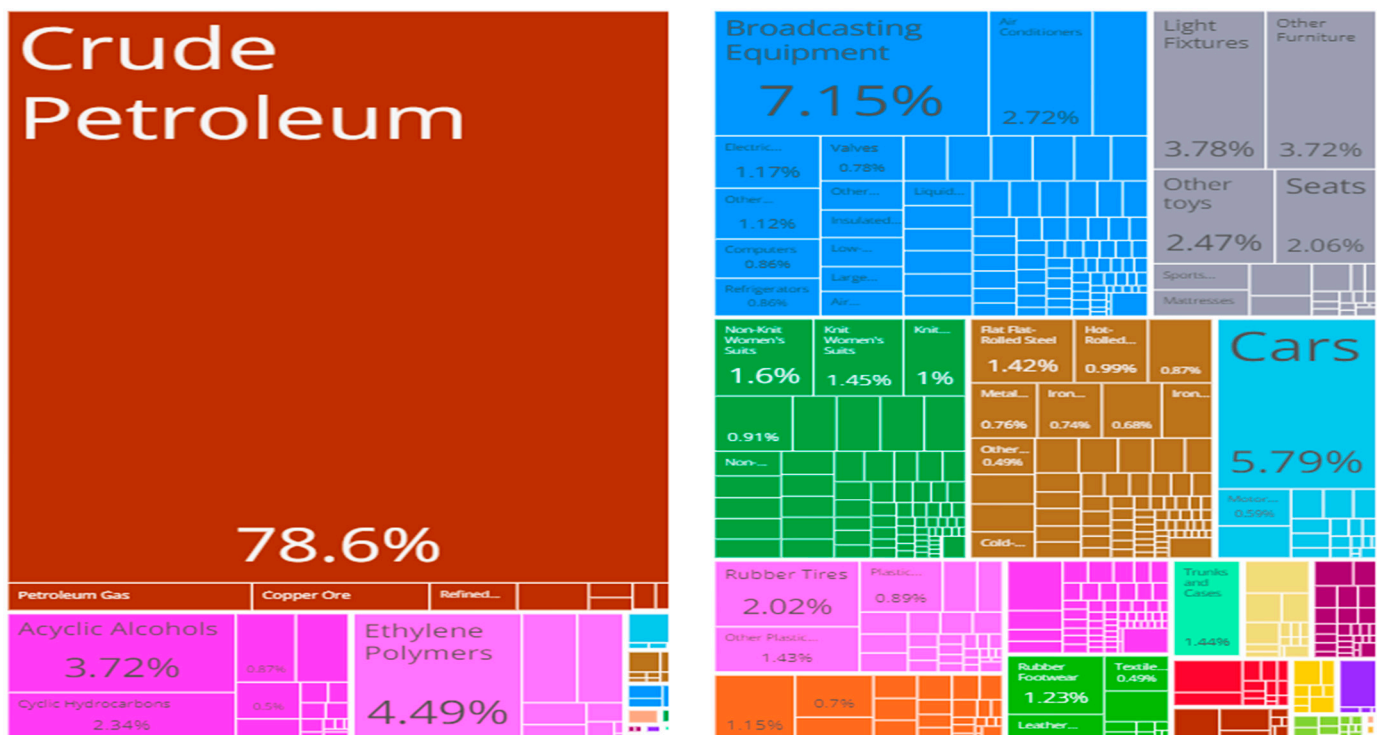


Figure 1. Exports from Saudi Arabia to China in 2021 and exports from China to Saudi Arabia in 2021. Source: OEC World [30].

Global uncertainty has significantly undermined business confidence, amplifying uncertainty with widespread effects on commodity and financial markets, supply chains, and global production networks. This situation has compromised food and energy security for consumers, leading to inflation and increased living costs. Additionally, the conflict has disrupted the global supply of metals like nickel, critical for clean-energy products, potentially complicating the transition to clean energy in the near term. Approximately 40% of maritime cargo includes fossil fuels. The maritime trade sector is undergoing transformation through digitalization efforts, which have accelerated post COVID-19, incorporating technologies such as the Internet of Things (IoT), blockchain, big data, and AI to enhance efficiency, sustainability, and resilience. Previously slow to adopt digital solutions, the maritime transport sector is now rapidly catching up to integrate these advanced technologies [31].

The Saudi Arabian ports' Liner Shipping Connectivity Index (LSCI) from 2006 to 2022 demonstrates a general upward trend, reflecting enhanced maritime connections. The rise in the connectivity index of China reflects its expansive maritime infrastructure development, extensive investments in port facilities, and its assertive participation in global maritime trade. The increase seen in China's index points to the country's rising prominence in global logistics and its ability to influence trade flows and maritime networks. A part of the increase can be associated with the BRI, which aims to strengthen trade links between China and the rest of the world, particularly through the creation of a maritime silk road. According to the UNCTAD Handbook of Statistics 2023, China was the best-connected economy to the global liner shipping network in Q3 2023, with an LSCI score of 75 [29].

While China has been a significant exporter of maritime goods to Saudi Arabia, as shown in Tables 2 and 3, particularly in the 'Ships, port equipment, and parts thereof' category, there is a noticeable decrease in the exports of ships, port equipment, and parts thereof from China to Saudi Arabia over the years, declining from \$811.28 million in 2012 to \$151.22 million in 2021. This might suggest a maturing or saturation of the market, changes in Saudi Arabia's procurement strategies, or shifts in Chinese manufacturing focus. The sector of high-technology and other manufactures has shown variability with a significant increase in 2020 and 2021, which could reflect an increased demand for advanced technology products in Saudi Arabia or a diversification of Chinese exports.

Table 2. Value of maritime goods exports from China to Saudi Arabia in million dollars at current prices (2012–2021).

Year	Marine Fisheries, Aquaculture, and Hatcheries	Seafood Processing	Sea Minerals	Ships, Port Equipment, and Parts Thereof	High-Technology and Other Manufactures
2012	3.467301	12.600405	0.006471	811.281141	153.652028
2013	2.990861	7.376872	0.059358	576.346918	163.693996
2014	3.080583	10.762019	0.017202	491.647604	241.932072
2015	2.392539	13.892134	0.020312	404.860056	223.800653
2016	4.055293	8.538384	0.021899	336.01063	154.762562
2017	5.984139	6.845285	0.024577	504.301851	155.511368
2018	7.273049	24.407227	0.034114	441.092557	139.604548
2019	8.028187	29.905686	0.087087	375.565235	198.171919
2020	2.625364	5.235185	0.035015	348.825931	308.776163
2021	2.49488	4.051819	0.029344	298.742034	324.811046

Source: UNCTAD [29].

Table 3. Total maritime goods exports from Saudi Arabia to China in million dollars at current prices (2012–2021).

Year	Marine Fisheries, Aquaculture and Hatcheries	Seafood Processing	Sea Minerals	Ships, Port Equipment and Parts Thereof	High-Technology and Other Manufactures
2012	0	0	0.287734	2.132082	45.629017
2013	0	0	0.0624	38.880435	30.264252
2014	0	0	0	0.61933	54.411214
2015	0	0	0	0.09467	27.568955
2016	0	0	0	29.020062	39.545555
2017	0	0.053865	0	9.455668	49.540523
2018	0	0.034139	0	7.561958	59.65882
2019	0	0.041619	0	0.001373	75.726778
2020	0	0.019249	0	174.423879	65.905891
2021	0.20496	0.004821	0	151.220727	69.698455

Source: UNCTAD [29].

4. Cultural Convergence and Trade: Dimensions and Drivers

Culture can be defined as “the collective mental programming of the human mind that distinguishes one group of people from another”. This mental programming shapes individuals’ patterns of thinking and influences the meanings they ascribe to various aspects of life, which in turn become embedded in a society’s institutions. It is important to emphasize that culture does not imply uniformity among all members of a society. In fact, intra-country variation in individual values often exceeds the differences observed between countries. Nevertheless, it remains methodologically valid to utilize country-level cultural scores, as these are derived from the law of large numbers and the premise that individuals are significantly influenced by prevailing social norms and mechanisms of social control. It is essential, however, to interpret such cultural generalizations with caution. A country’s cultural score is only meaningful when assessed in comparison to those of other countries, and such statements should always be understood as relative rather than absolute measures [32,33].

4.1. Trade and Culture Dimensions

The concept of cultural dimensions is the main factors that explain the differences and similarities among national and regional cultures. Hofstede et al. [34] explore the dimensions of national cultures and their implications for various aspects of human life. Cultural dimensions offer a valuable lens through which to understand the underlying social and behavioral factors that shape international trade relations. Although these dimensions are crucial in framing the broader context of bilateral cooperation, the available data remains largely qualitative and lacks the consistency or granularity required for direct inclusion in the econometric model. Therefore, this section is presented separately to clarify how cultural factors may influence trade patterns. The six dimensions of culture provide insights into how societies organize themselves and approach various aspects of life. Each dimension is expressed on a scale that roughly ranges from 0 to 100 as seen in Figure 2.

Both China and Saudi Arabia demonstrate high power distance and a collectivist cultural orientation, indicating a strong emphasis on hierarchical structures and group cohesion. However, China exhibits a slightly more masculine and competitive cultural profile, emphasizing achievement and success more than Saudi Arabia. Additionally, China displays a greater tolerance for uncertainty and possesses a strong long-term orientation, reflecting its strategic and future-focused planning. In contrast, Saudi Arabia tends to favor more structured, stable environments and demonstrates a relatively short-term

outlook. Both nations are categorized as restrained societies, though this tendency is more pronounced in the Saudi context. The cultural dimensions presented in Table 4 provide valuable insights for practitioners and policymakers in understanding how cultural norms may influence business practices, team management, and diplomatic engagement between the two countries.

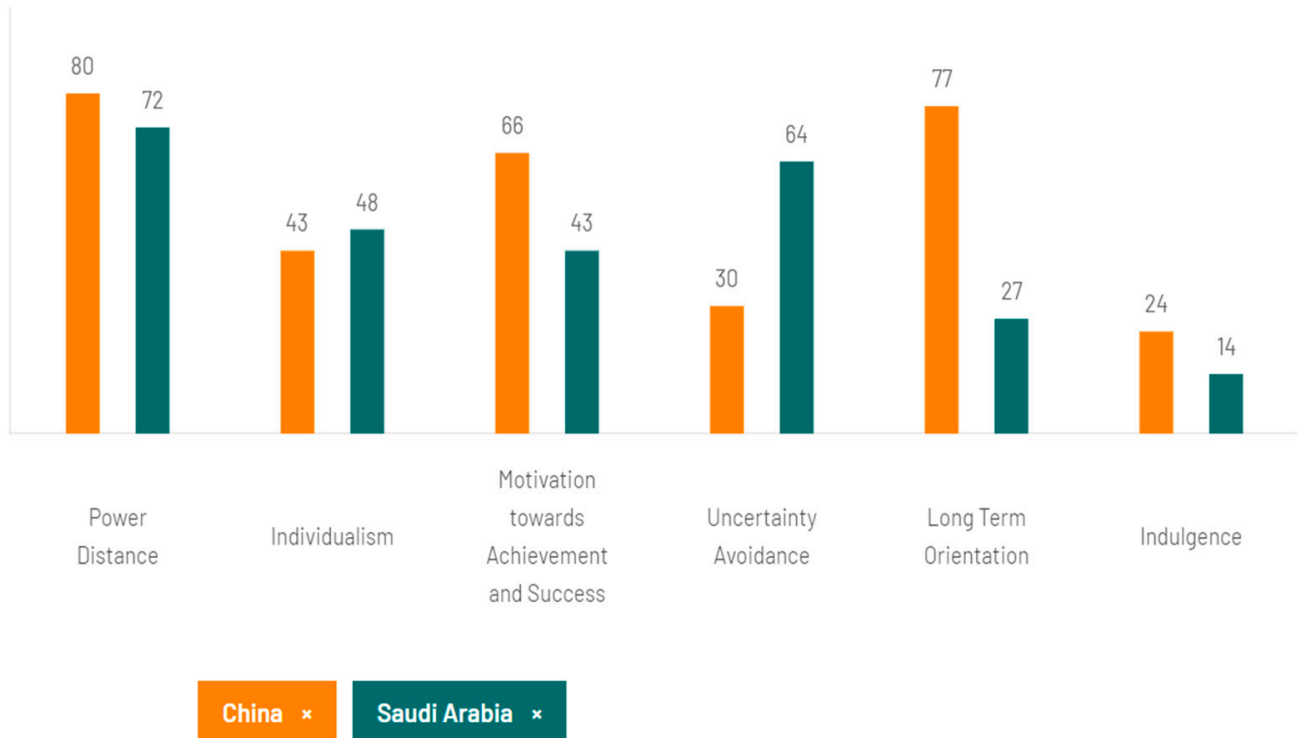


Figure 2. Country comparison tool. Source: Hofstede Insights [32,34].

The study by Mornah and MacDermott [9] illustrates that increasing the differentials relative to a trading partner improves trade performance, innovation, and efficiency, which contributes to increased competitiveness. Societies with relatively higher levels of uncertainty avoidance also prefer to pursue foreign markets through trade rather than foreign direct investment (FDI), because the risks of trade are lower than those of FDI.

Business interactions become more formal in an attempt to reduce risk or uncertainty. long-term orientation represents the extent to which certain behaviors such as planning and deferring gratification are rewarded, as they are considered essential pillars of competitive advantage. These rewards naturally increase as future orientation becomes more pronounced. There is a difference between individualism and collectivism. Individuals who lack cooperation will be unable to make the necessary compromises to achieve international success, as the nature of international business appears to require a tremendous deal of cooperation, understanding, and compromise. Motivation for achievement and success fosters innovation and productivity, which in turn enhances international competitiveness by increasing both the volume of production and the value of goods produced due to this propensity for innovation. When it comes to indulgence, the more disciplined societies prioritize controlling desires and entertainment, emphasizing the importance of adhering to social norms, raising their business performance, competitiveness, and trade volume.

Table 4. The six dimensions of culture.

Dimensions	Description	China	Saudi Arabia
Power Distance Index (PDI)	This dimension reflects the societal acceptance of inequality and the distribution of power. It describes how cultures perceive and tolerate disparities among their members, focusing on the degree to which individuals in less powerful positions within organizations and institutions recognize and endorse the uneven allocation of power.	With a Power Distance Index (PDI) of 80, China ranks high, indicating a societal acceptance of inequality. Relationships between subordinates and superiors are distinctly hierarchical, with little safeguard against the misuse of power by those above. Respect for formal authority and the belief in the potential for leadership and initiative are prevalent, while ambitions are expected to align with one's social standing.	Saudi Arabia, with a PDI score of 72, shows a strong acceptance of structured hierarchies and centralized authority within organizations, reflecting societal acceptance of inherent inequalities. The culture endorses a clear hierarchical order that does not require justification, where subordinates anticipate directives and the ideal leader is viewed as a benevolent autocrat.
Individualism (IDV)	The Individualism vs. Collectivism (IDV) dimension assesses whether a culture values personal independence and self-reliance or prioritizes group cohesion and interdependence. In individualistic societies, personal achievements and freedom are emphasized, while in collectivist cultures, the focus is on group goals, harmony, and mutual support.	China is characterized by a collectivist culture, indicated by a score of 43, emphasizing group over individual interests. This approach influences workplace dynamics, where decisions regarding hiring and promotions often favor those within a closer social circle, such as family. There is a generally low employee allegiance to colleagues, with a distinction between in-group cooperation and out-group detachment. Personal connections are prioritized above professional responsibilities and organizational objectives.	Saudi Arabia is mildly collectivist with a score of 48, emphasizing long-term commitment within groups such as family and extended relationships. Loyalty is highly valued, often superseding societal norms. The culture promotes strong, responsible relationships within groups, where personal offenses can lead to shame. In the workplace, relationships often mirror familial ties, with hiring and promotions favoring in-group members, and management focusing on group dynamics.
Motivation towards Achievement and Success	A society with a high score on this dimension prioritizes competition, achievement, and success, where being the best is the ultimate goal, beginning in education and persisting in the workplace. Conversely, a low score reflects a society valuing care for others and quality of life over individual achievements, where collective well-being and enjoying one's work take precedence over competition. This distinction highlights the underlying motivations driving societal behavior: the pursuit of excellence versus the satisfaction in one's endeavors.	With a score of 66, China places a strong emphasis on achievement and success. This cultural priority is evident in the willingness of individuals to forego personal time and family commitments for work opportunities, often working late hours and even relocating for better jobs. Education is also highly competitive, with students placing great importance on exams and rankings as measures of success. This drive for achievement permeates various aspects of Chinese society, prioritizing work and educational accomplishments over leisure.	With a score of 43, Saudi Arabia is identified as a society leaning more towards consensus, where there is a balanced emphasis on collective agreement and quality of life rather than on individual achievement and success.

Table 4. Cont.

Dimensions	Description	China	Saudi Arabia
Uncertainty Avoidance Index (UAI)	UAI measures a society's tolerance for uncertainty and ambiguity. Societies with high UAI prefer clear rules and structures to manage unpredictability, seeking security in established norms. Conversely, cultures with low UAI are more adaptable, embracing change and uncertainty with ease, without the need for strict rules or predictable outcomes.	With a score of 30, China exhibits low Uncertainty Avoidance, indicating a society that is comfortable with ambiguity and pragmatic in its adherence to rules and laws. This flexibility in rule-following allows for adaptability and entrepreneurship, characteristics seen in the prevalence of small-to-medium-sized, family-owned businesses. The Chinese language's ambiguity reflects this comfort with uncertainty, challenging those from more literal cultures. This adaptability and entrepreneurial spirit are key to understanding China's business landscape.	Saudi Arabia, with a score of 64 on Uncertainty Avoidance, shows a societal preference for structure and predictability. This indicates a culture with strict beliefs and behaviors, low tolerance for unconventional ideas, a significant need for rules, emphasis on hard work and punctuality, resistance to innovation, and a high value placed on security in motivating individuals.
Long-Term Orientation (LTO)	LTO assesses whether a society values long-term commitments and respect for tradition or prioritizes short-term gains and social norms. Cultures with a long-term orientation focus on future rewards, emphasizing perseverance, saving, and adaptability to changing circumstances.	With a score of 77, China is identified as a highly pragmatic culture, valuing adaptability, long-term planning, and resourcefulness. This pragmatism is reflected in a flexible approach to truth, based on context and time, and a focus on saving, investing, and perseverance towards long-term goals.	Saudi Arabia's score of 27 in this dimension reflects its normative cultural orientation, emphasizing respect for traditions, a focus on absolute truths, and a preference for quick results over long-term savings. This indicates a society where traditional norms and immediate outcomes are prioritized.
Indulgence	This dimension measures the degree to which societies regulate or indulge in desires and impulses, influenced by upbringing. "Indulgence" signifies a society allowing relatively free gratification of basic human desires, while "Restraint" denotes societies where desires are strictly controlled. Cultures are thus categorized as either indulgent, showing leniency towards gratification, or restrained, emphasizing strict discipline and denial of gratification.	With a score of 24, China is classified as a Restrained society, indicating a tendency towards cynicism and pessimism. Unlike indulgent cultures, restrained societies place less value on leisure and more on controlling desires. Individuals in these societies often feel their behaviors are limited by social norms and view self-indulgence with skepticism.	Saudi Arabia, scoring 14 on this dimension, is markedly a Restrained society. This score reflects a cultural orientation that prioritizes strict control over desires and leisure, emphasizing the importance of adhering to social norms. Individuals in such societies often believe that self-indulgence is inappropriate, guided by a strong sense of restraint shaped by societal expectations.

Source: Hofstede Insights [32].

Furthermore, the relationship between cultural exchange and international trade can be explained from three dimensions: enhancing cultural identity, reducing trade costs, and exchanging information. Improving cultural identity by offering Chinese language and culture courses while supporting Chinese activities and performances contributes to building a positive image of China and reducing the contradictions and conflicts arising from cultural diversity. Also, reducing trade costs is crucial, given that linguistic and cultural disparities significantly impede the growth of international trade and escalate its

expenses. Therefore, cultural convergence contributes to reducing communication costs in trade negotiations and promoting trade growth. This process is in addition to information exchange; cultural exchange contributes to gaining information about trading partners and their market conditions. As a platform for exchanging economic, cultural, and political information, it improves the level of openness, ultimately boosting imports and exports from China and partner countries [17].

4.2. Creative and ICT Goods Trade as Drivers of Culture Convergence

According to the OECD [35], there is a significant connection between culture and creative sectors. These sectors, often referred to as the Cultural and Creative Sectors (CCS), encompass a wide range of areas including heritage, archives, libraries, literature, press, visual and performing arts, audiovisual and multimedia content, architecture, design, cultural education, and artistic crafts. In the digital realm, cultural products such as e-books, music, videos, and games represent the largest revenue stream within the digital economy. Moreover, creative goods play a crucial role in driving trade. On the other hand, the creative goods trade also has implications for cultural dynamics, as the types of goods traded can influence and reflect cultural tastes, trends, and exchanges. In light of this, China's exports of creative goods to Saudi Arabia, as shown in Table 5, can be used as evidence of the cultural convergence between the two countries through the increase in the volume of these exports and the demand for them from Saudi Arabia.

Table 5. Top 10 items of creative exports from China to Saudi Arabia in million dollars at current prices (2012–2021).

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
All creative goods	1717	1826	1820	2246	1851	1925	1838	2777	3277	3378
Design	1375	1443	1516	1919	1559	1675	1581	2420	2889	2940
Interior	748	793	831	1111	841	826	747	1124	1498	1558
Toys	93	82	98	140	164	287	335	570	939	775
Fashion	481	502	525	611	517	508	464	676	410	491
Art crafts	120	120	129	168	125	142	131	162	191	186
Visual arts	149	198	128	116	127	79	76	123	122	132
Sculpture	146	194	125	111	123	77	74	120	118	125
jewelry	9	25	48	49	31	48	31	46	38	108
New media	45	47	31	27	26	15	39	56	55	104
Video games	19	19	8	8	4	4	29	43	44	93

Source: UNCTAD [29].

There is a clear upward trend in the total value of all creative goods exported from China to Saudi Arabia, growing from \$1.717 billion in 2012 to \$3.378 billion in 2021. Design and interior hold the highest value among creative goods throughout the years. This asserts an increasing demand for Chinese creative goods in Saudi Arabia. The overall growth in exports, especially in categories that reflect current digital trends like new media and video games, suggests an alignment or convergence of cultural interests and consumption patterns between China and Saudi Arabia. It is also an indicator of strong trade relations and cultural exchange between the two countries, potentially facilitated by trade agreements and cultural initiatives. In 2020, Saudi Arabia conducted a comprehensive survey focused on the involvement of its citizens in cultural activities to guide the development of forthcoming cultural policies which will be designed to dismantle social hurdles to cultural engagement and enhance the overall well-being of the population through cultural means [36].

According to the data provided by the UNCTAD database website about the creative goods exports in 2021 from Saudi Arabia to China, the total exports of creative goods

from China to the world amounted to 234,050 million dollars, and the exports directed to the Saudi market were 3378 million dollars at current prices. The total exports of creative goods from China to the Saudi market constitute about 1.44% of its total creative exports. This percentage is modest compared to the overall volume of exports. Meanwhile, Saudi Arabia's exports were 451 million dollars in 2021, and what it exports to China was 17 million dollars. Saudi Arabia's exports of creative goods to China in 2021 account for about 3.77% of its total creative exports. This percentage indicates that China is considered a relatively secondary market for Saudi creative goods. Although this percentage is higher than the previous one related to China's exports to Saudi Arabia, it still represents a small part of the total. This may suggest the potential for enhancing trade in creative goods between the two countries. On the other side, the export value of creative goods from Saudi Arabia to China has experienced significant fluctuations, with a sharp decline from a peak of 125 million US dollars in 2016 to 17 million US dollars in 2020, at current prices. This downturn may specifically reflect its sensitivity to the global impact of the COVID-19 pandemic, which disrupted supply chains, trade, and consumer spending worldwide [35].

Furthermore, there is a relationship between ICT goods exports and cultural convergence. The export of ICT goods facilitates the flow of information, ideas, and cultural content across borders. As countries import and export ICT goods, they also exchange cultural products and services enabled by these technologies, leading to cultural convergence. For example, smartphones and the internet allow for the global dissemination of music, films, and art, making cultural products from one country easily accessible worldwide. China is one of the world's largest producers and exporters of ICT goods; this can introduce Saudi Arabian consumers to Chinese culture, values, and societal norms, fostering a greater understanding and appreciation of Chinese culture. China's exports to Saudi Arabia include a range of technology products that facilitate information exchange and communication. This can be explored by reviewing Figure 3.

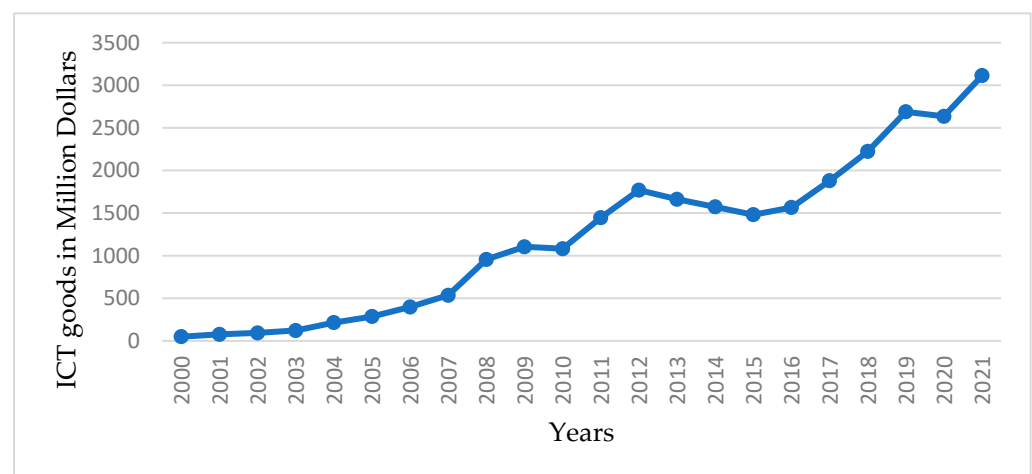


Figure 3. Total ICT goods exports from China to Saudi Arabia in million dollars at current prices (2000–2021). Source: UNCTAD [29].

There has been significant growth in the value of ICT goods exports from China to Saudi Arabia from \$50 million in 2000 to \$3114 million in 2021, representing a 6128% increase. This substantial growth percentage highlights a significant expansion over the 21 years and indicates strengthening trade ties in the sector of technology between the two nations and reflects Saudi Arabia's increasing demand for ICT products, possibly driven by its efforts towards digital transformation and economic diversification under initiatives like Vision 2030. Despite the notable development in Chinese exports of ICT goods to Saudi Arabia, they still constitute a very small percentage of China's total exports in these

goods, not exceeding 0.4% in 2021. This can be declared in Table 6. The relatively small share of exports to Saudi Arabia, despite recent growth, indicates potential for further expansion. As Saudi Arabia continues to invest in technology and infrastructure, there may be opportunities for China to increase its market share. It also suggests a growth in communication equipment to be a significant contributor to the total value. The increase in ‘Electronic components’ and ‘Miscellaneous’ in the latter years might indicate new developments or increased diversity in ICT products and components exports.

Table 6. ICT goods exports from China to Saudi Arabia in million dollars at current prices (2012–2021).

ICT Items	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total	1769	1662	1572	1480	1565	1879	2222	2688	2635	3114
% World	0.32	0.27	0.26	0.25	0.28	0.31	0.33	0.41	0.38	0.36
Computers and peripheral equipment	343	303	286	183	181	220	227	300	299	384
Communication equipment	946	846	775	724	912	1154	1453	1666	1584	1968
Consumer electronic equipment	438	464	469	524	420	470	493	575	683	692
Electronic components	15	24	16	23	23	14	33	122	34	35
Miscellaneous	27	25	27	26	29	21	16	26	35	36

Source: UNCTAD [29].

5. Data and Econometric Methodology

5.1. Data

The analysis is based on quarterly time series data covering the period from 2012 to 2021, with a specific focus on maritime trade between China and Saudi Arabia. Maritime trade figures, along with data on creative goods exports (CRE) and information and communication technology (ICT) goods exports, are obtained from the United Nations Conference on Trade and Development (UNCTAD). Population data (POP), included as a control variable to account for demographic scale effects, is sourced from the World Bank’s World Development Indicators (WDI). These variables are selected for their relevance to the study’s objective of examining the relationship between cultural convergence and maritime trade. Table 7 provides a detailed summary of the variables used, including their definitions and sources, selected based on their reliability, comprehensiveness, and accessibility.

Table 7. Variables description.

Variables	Description	Sources
Maritime Trade (MT)	The transport of goods overseas between two countries as the dependent variable.	UN Trade and Development (UNCTAD)
Creative Goods Export (CRE)	Creation, production, and distribution cycles that leverage creativity and intellectual capital, which is the main regressor.	UN Trade and Development (UNCTAD)
Information and Communication Technology (ICT) Goods	Computer and communications services (telecommunications and postal and courier services) and information services (computer data and news-related service transactions), which is the second regressor.	UN Trade and Development (UNCTAD)
Population (POP)	The whole number of people in a country, which is the third regressor.	World Bank

5.2. Methodology

This study seeks to examine the causal relationship between maritime trade and cultural convergence by employing a time series econometric framework capable of producing reliable inferences in the presence of potentially non-stationary variables. To this end, the Toda–Yamamoto Granger causality test [37] is utilized. This methodology offers a robust approach to causality testing, as it permits the analysis of level data without requiring transformation into stationary series or the prior assessment of cointegration. Consequently, it minimizes the risk of pre-test biases and is particularly well-suited for applied empirical research involving macroeconomic time series with uncertain integration properties. The study establishes a theoretical framework to explore the dynamic relationship of MT, CRE, ICT, and POP in Saudi Arabia. The model is organized as follows:

$$MT = f(CRE, ICT, POP) \quad (1)$$

From Equation (1), the preliminary econometric model can be derived as:

$$MT = \beta_0 + \beta_1 CRE + \beta_2 ICT + \beta_3 POP + \mu_t \quad (2)$$

where μ_t is the random error term; β_0 is the constant term; β_1 , β_2 , and β_3 are the equation coefficients.

The Toda–Yamamoto Granger causality test is employed in this study to examine the direction of causality among the selected variables (see Appendix A). Originally proposed by Toda and Yamamoto [37], this method estimates a Vector Autoregression (VAR) model using level data and facilitates causality testing without the need to transform variables into stationary series. Unlike the traditional Granger causality approach, the Toda–Yamamoto procedure effectively addresses issues related to non-stationarity and cointegration among variables by circumventing pre-tests for unit roots and cointegration to estimate a Vector Autoregression (VAR) model using data in levels and test causality. This approach addresses issues found in the traditional Granger causality test by avoiding any possible non-stationary or cointegration among the variables during the causality test. One of its key strengths lies in its applicability regardless of whether the underlying series are integrated of order I (0), I (1), or I (2), or whether they are cointegrated. This flexibility enables researchers to conduct causality tests free from biases that may arise from pretesting procedures [37–40]. The method augments the standard VAR model by including the maximum order of integration across the variables, thereby preserving the validity of the asymptotic distribution of the Wald test statistics. This robustness makes it a particularly suitable tool for empirical investigations involving time series data with uncertain integration properties.

The application of the Toda–Yamamoto Granger causality test involves several procedural steps [41]. First, the optimal lag length k is determined using standard lag selection criteria such as the Akaike Information Criterion (AIC) or Schwarz Bayesian Criterion (SBC). Subsequently, the maximum order of integration d_{max} is identified based on unit root tests. For instance, if the variables are found to be integrated at levels I (0), I (1), and I (2), then d_{max} will be 2. It is essential to ensure that the lag length k is greater than or equal to d_{max} , i.e., $k \geq d_{max}$. Thereafter, a VAR model of order $(k + d_{max})$ th is estimated, and the Block Exogeneity Wald test is applied to assess the direction of causality. The test statistic follows a chi-squared distribution with k degrees of freedom, which allows for valid statistical inference regarding the existence and direction of causal relationships. The stages are shown in Figure 4.

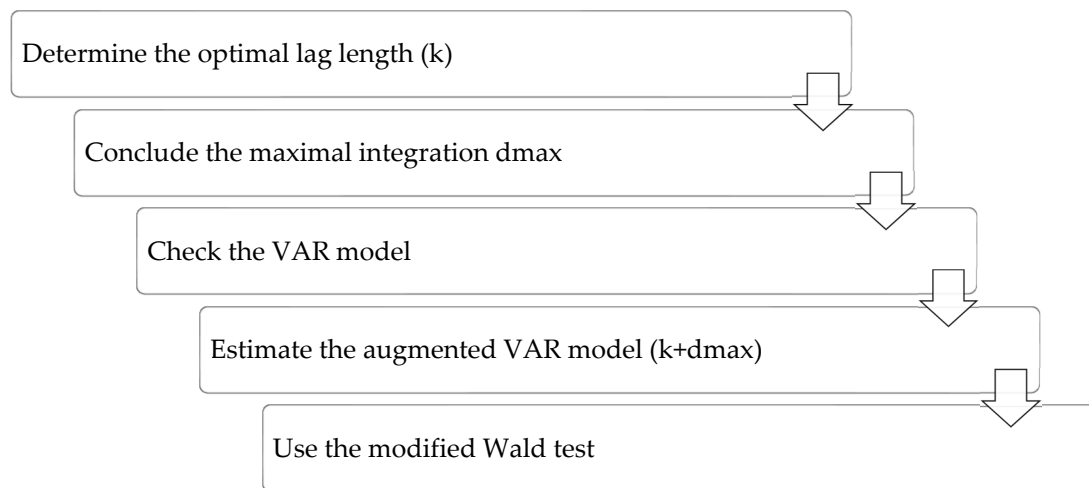


Figure 4. The stages of Toda–Yamamoto Granger causality test.

The Toda–Yamamoto procedure presents several notable methodological advantages. Primarily, it accommodates non-stationary time series without necessitating differencing or prior cointegration testing, thereby minimizing the risks associated with pre-test biases [42]. Additionally, the approach offers a straightforward and flexible framework based on an augmented VAR model, enabling consistent inference even when the variables exhibit differing orders of integration [43]. Its robustness to mixed integration orders renders it particularly suitable for applied empirical research contexts in which the integration properties of the time series are uncertain [44].

Despite these strengths, the Toda–Yamamoto procedure is subject to certain limitations. Notably, it tests for statistical precedence rather than structural or economic causality, thereby constraining the interpretation of causality results within a policy framework [45]. Furthermore, by circumventing cointegration analysis, the method does not explicitly account for long-run equilibrium relationships among variables [42]. Lastly, the validity and reliability of causality inferences derived from the Toda–Yamamoto approach critically depend on the appropriate selection of lag length and accurate determination of the maximal order of integration, both of which can influence the robustness of the results [45].

In sum, the Toda–Yamamoto Granger causality test constitutes a robust and statistically rigorous methodological framework for investigating dynamic relationships among variables in the presence of unit roots. Its flexibility aligns well with the objectives of this study, while its inherent limitations are duly acknowledged and carefully considered in the interpretation of empirical findings. This integrated methodology is particularly well-suited to the context of Saudi Arabia’s economy and China, where the impact of creative and information and communication technology goods on the global trade is noticeable. In addition, population size is one of the factors that may have an impact on the global maritime trade.

6. Empirical Results and Discussion

Pre-testing for statistical properties of the variables such as non-stationarity test for time series data is important to avoid spurious results. The order of integration $I(d)$ will be identified using Phillips–Perron (PP) method [46] for the unit root test. The PP test cross checks the stationarity properties of every time series variable. The PP test does not require adding lagged difference terms to account for serial correlation as like Augmented

Dickey–Fuller (ADF) Test, i.e., no need to add lagged difference term. Hence, the PP test is based on the following regression equation:

$$\Delta Y_t = \alpha_0 + \gamma t + \delta Y_{t-1} + \varepsilon_t \quad (3)$$

The null hypothesis of the PP test is $H_0 : \delta = 0$, i.e., the time series is non-stationary (has a unit root). Table 8 presents the PP unit root test results conducted on the variables in their level and difference forms. The purpose of this test is to know the highest order of integration of the variables (d_{max}). The results reveal that MT is stationary at the level, i.e., it integrated in 0 (I (0)), while the other variables integrated at order 2 (I (2)). Hence, all the variables are integrated at I (0) and I (2).

Table 8. Unit root test.

Variables		Level	First Difference	Second Difference	Order of Integration I (d)
MT	Adj t-Stat	−3.435659	-	-	I (0)
	critical	−2.945842	-	-	
	Prob.	(0.0161)	-	-	
CRE	Adj t-Stat	0.013089	−1.780727	−2.689788	I (2)
	critical	−2.945842	−1.950687	−1.951000	
	Prob.	(0.9537)	(0.0714)	(0.0087)	
ICT	Adj t-Stat	1.313362	−0.708336	−2.249313	I (2)
	critical	−2.945842	−1.950687	−1.951000	
	Prob.	(0.9982)	(0.4027)	(0.0256)	
POP	Adj t-Stat	−2.639918	−1.872908	−2.115859	I (2)
	critical	−2.945842	−1.950687	−1.951000	
	Prob.	(0.0946)	(0.0631)	(0.0348)	

Source: prepared by the researcher, depending on the program EViews 12.

The study investigates the direction of causality via VAR model. The optimum lag length (k) is determined by using likelihood ratio (LR), FPE, Akaike Information Criterion (AIC), Schwarz Criterion (SC), and HQ criterion. Table 9 presents the output of the lag selection criteria based on VAR framework. Lag selection is one of the most important aspects in time series analysis and also it is necessary to determine the appropriate optimal order of lag length as a precondition for estimating Toda–Yamamoto causality. Based on the minimum value of AIC, FPE, and HQ criteria, the optimal lag length (k) is 6.

Table 9. Vector autoregression (VAR).

Lag	Log L	LR	FPE	AIC	SC	HQ
0	−1521.982	NA	6.71×10^{37}	98.45045	98.63548	98.51077
1	−1232.995	484.7520	1.52×10^{30}	80.83840	81.76356	81.13998
2	−1059.953	245.6077	6.42×10^{25}	70.10668	72.37195	71.249520
3	−921.173	161.1649	2.71×10^{22}	62.78533	65.19073	63.56943
4	−883.799	33.7571	9.41×10^{21}	61.40637	64.55189	62.43173
5	−682.713	129.7328	1.16×10^{17}	49.46535	53.35099	50.73197
6	−419.740	101.7959 *	5.14×10^{10} *	33.53161 *	38.15738 *	35.03950 *

* Indicates lag order selected by the criterion. LR: Sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan–Quinn information criterion. Source: Prepared by the researcher, depending on the program EViews 12.

The lag exclusion Wald test based on the chi-squared test statistic is used to assess the significance at different lags. The test results presented in Table 10 excludes all lags except lag 2. Test statistics are not available for sets of lag coefficients with restrictions. It is significant at lag 2; therefore, the optimum length $k = 2$.

Table 10. VAR lag exclusion test.

	MT	CRE	ICT	POP
Lag 1	1400.438 [0.0000]	321.4806 [0.0000]	515.8616 [0.0000]	855.9552 [0.0000]
Lag 2	455.0856 [0.0000]	947.3936 [0.0000]	144.9993 [0.0000]	252.3924 [0.0000]

Source: Prepared by the researcher, depending on the program EViews 12.

The unit root test result already indicates that the maximum order of integration is $I(2)$, which implies that the d_{max} is 2. Therefore, the $(k + d_{max})$ th order, i.e., the 4th order VAR needed to be run through the Toda–Yamamoto procedure, and thus presented the Granger causality or Block Exogeneity Wald test results as seen in Table 11.

Table 11. Toda–Yamamoto Causality test result.

Cause	Wald Statistic Chi-Squared	Probability-Value (<i>p</i> -Value)
CRE → MT	132.8747	0.0000
ICT → MT	97.47595	0.0000
POP → MT	73.80341	0.0000
MT → CRE	8.038658	0.0180
ICT → CRE	4.642749	0.0981
POP → CRE	19.95078	0.0000
MT → ICT	12.39070	0.0020
CRE → ICT	4.386837	0.1115
POP → ICT	3.105710	0.2116
MT → POP	5.049702	0.0801
CRE → POP	1.494005	0.4738
ICT → POP	0.732785	0.6932

Source: Prepared by the researcher, depending on the program EViews 12.

Based on the results of Table 10, we can reject the null hypotheses (i.e., the predictors do not cause maritime trade), as MT, CRE, ICT, and POP are significantly caused by one or more of the regressor variables. The dependent variable MT is significantly affected by all regressors. Moreover, MT causes both CRE ($p = 0.0180$) and ICT ($p = 0.0020$), but does not Granger-cause POP ($p = 0.0801$).

The empirical results, employing the Toda–Yamamoto approach, uncover many different causal linkages. These empirical results support the convergence theory proposed by Kerr, Harbison, Dunlop, and Myers [7], which asserts that increased interactions—through industrialization, trade, and communication—foster cultural and institutional alignment between nations. Creative products, ICT exports, and population in Saudi Arabia significantly impact maritime trade. All factors significantly influence MT, with bidirectional causation present between CRE and MT, as well as between ICT and MT; however, no bidirectional causality is shown between POP and MT. This aligns with the view that culture is a source of competitive advantage in international trade, as noted by Gouvea and Vora [19] and Mornah and MacDermott [9], who emphasize the impact of creative and knowledge-based sectors on economic growth and trade performance.

Furthermore, these results reflect the recent literature on the Belt and Road Initiative, particularly studies by Li, Han, Li, Wei, and Zhang [17] and Liu, Lu, and Wang [22], which highlight how cultural exchange mechanisms—such as ICT infrastructure and creative service exports—enhance bilateral trade by reducing cultural distance and fostering mutual understanding. The Saudi experience demonstrates similar dynamics, where the promotion of creative sectors and technological engagement serves as a bridge for deeper economic integration, particularly with strategic partners like China.

The lack of significant causality between population and maritime trade suggests that demographic scale alone is insufficient to influence trade flows in the absence of qualitative cultural and technological engagement. This aligns with studies (e.g., Xu, Li, Shen, and Zhou [21]) that show cultural distance—not population size—as a more relevant factor in determining trade dynamics, especially when it follows a non-linear or U-shaped pattern of influence. The lack of reverse causation indicates that enhancements in marine trade do not directly affect population growth, which is predominantly influenced by demographic and policy issues [47].

These results are useful for filling the gap in the literature noted in earlier sections, offering new empirical insight into the underexplored cultural–economic interplay within the China–Saudi Arabia maritime trade relationship. This makes it a matter of interest to policymakers involved in formulating policies and developing targeted interventions to improve the conditions for cultural convergence with China. The study suggested that governments should pay more attention to the economic impact of cultural factors on international trade; policymakers can identify aspects of culture that promote competitiveness through education or concerted efforts to promote cultural interaction with selecting partners. These findings substantiate convergence theory by demonstrating how enhanced economic and cultural exchanges may mutually evolve and influence one another over time [48]. Furthermore, they correspond with actual research indicating that the creative and ICT industries frequently serve as drivers for extensive economic integration.

7. Conclusions

This study makes a valuable contribution by investigating the important connection between China–Saudi maritime trade and cultural exchanges, underscoring a significant disparity in the scale and impact of their global maritime trade engagements. China’s maritime growth outpaces Saudi Arabia’s, reflecting its expansive infrastructure and strategic initiatives. Despite Saudi Arabia’s growth and its exports of creative goods to China—representing a potential area for expansion—the trade in creative goods remains modest. The relationship between ICT goods exports and cultural convergence highlights both opportunities for global understanding and challenges related to cultural diversity. Optimizing this relationship requires navigating the balance between embracing technological integration and preserving cultural uniqueness [9,17,19,20].

The empirical analysis, utilizing the Granger causality test applied in the VAR model with the Toda–Yamamoto procedure and supported by Phillips–Perron unit root testing, reveals several distinct causal relationships. It is concluded that creative goods, ICT exports, and population in Saudi Arabia have a considerable influence on maritime trade. All variables have a significant impact on MT, with causality between CRE and MT and between ICT and MT operating bidirectionally, while no bidirectional causality exists between POP and MT. These results are consistent with related theories and prior studies [49,50].

The study’s findings align with Saudi Vision 2030, which aims to build a diversified economy less dependent on oil. The implementation of the Belt and Road Initiative in Saudi Arabia prioritize infrastructure development and industrial modernization, essential for the Kingdom’s aspiration to become a competitive global hub connecting Asia, Europe, and Africa. This strategic alignment provides significant opportunities for China to expand trade and investment activities while strengthening its domestic industrial economy. These dynamics extend beyond bilateral exchanges to encompass regional cooperation. Notably, seven Arab countries—Egypt, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates—are founding members of the Asian Infrastructure Investment Bank (AIIB), a Chinese-led multilateral institution that finances BRI projects. The AIIB’s priorities—including infrastructure, energy, full industrial chain development, and new technology—

are well aligned with the Sino–Saudi cooperation framework. Overall, the bank facilitates regulatory convergence and promotes trade and investment growth in the region, thereby supporting sustained Sino–Saudi cooperation.

Despite these contributions, the study faces a core limitation in the limited availability of key cultural convergence indicators. The reliance primarily on creative goods and ICT exports as proxies for cultural exchange may not fully capture the complexity of cultural interactions, such as those manifested through education, tourism, or media flows. Greater data availability in the future will allow for more comprehensive research to revisit and deepen the understanding of the relationships explored herein.

The findings carry important policy implications that require concrete, actionable strategies. First, to enhance maritime trade efficiency, governments should invest in the digitalization of port infrastructure by implementing blockchain-based supply chain management systems and AI-driven logistics solutions to reduce customs delays and improve transparency. Second, establishing bilateral cultural trade councils could institutionalize ongoing dialog, facilitating joint programs that promote the co-production of creative content and technology transfer between the two countries. Third, educational exchanges should be expanded through scholarships and joint degree programs focused on digital media, maritime economics, and international trade law to cultivate skilled professionals adept at managing cultural and economic integration. Fourth, policymakers should develop export diversification initiatives, including incentives such as tax breaks and subsidies for Saudi creative and ICT exporters targeting the Chinese market, supported by market research and trade missions. Lastly, fostering multilateral cooperation through the AIIB and other regional bodies can streamline regulatory standards and harmonize customs procedures to facilitate smoother trade flows.

For future research, this paper recommends employing more comprehensive econometric analyses incorporating a wider range of cultural convergence indicators and adopting mixed-methods or panel data approaches to capture both quantitative and qualitative aspects of cultural trade. Further studies should explore the post-pandemic evolution of maritime cultural exchange, particularly the role of emerging technologies such as artificial intelligence, virtual reality, and digital media platforms. Additionally, examining the influence of multilateral institutions like the AIIB in promoting regulatory convergence and infrastructure development offers promising avenues for research.

In summary, this study contributes valuable insights into the impact of cultural convergence on maritime trade between Saudi Arabia and China. By implementing targeted and specific policy measures that integrate culture, technology, and trade, policymakers can foster a more resilient, diversified, and mutually beneficial bilateral relationship that supports broader regional economic stability and cultural enrichment.

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Appendix A. Toda–Yamamoto Model: Equations and Explanation

Appendix A.1. Mathematical Formulation

The Toda and Yamamoto [37] causality testing procedure begins by constructing an augmented VAR ($p + d_{max}$) model. The model equations are structured as follows:

$$MT_t = \alpha_0 + M + \gamma_{1t} \quad (A1)$$

$$CRE_t = \theta_0 + M + \gamma_{2t} \quad (A2)$$

$$ICT_t = \delta_0 + M + \gamma_{3t} \quad (A3)$$

$$POP_t = \omega_0 + M + \gamma_{4t} \quad (A4)$$

where

$$M \equiv \sum_{i=1}^k \alpha_{1i} MT_{t-i} + \sum_{i=k+1}^{d_{max}} \alpha_{2i} MT_{t-i} + \sum_{i=1}^k \theta_{1i} CRE_{t-i} + \sum_{i=k+1}^{d_{max}} \theta_{2i} CRE_{t-i} + \sum_{i=1}^k \delta_{1i} ICT_{t-i} + \sum_{i=k+1}^{d_{max}} \delta_{2i} ICT_{t-i} + \sum_{i=1}^k \omega_{1i} POP_{t-i} + \sum_{i=k+1}^{d_{max}} \omega_{2i} POP_{t-i} \quad (A5)$$

γ_{it} represents the residual term of the model.

Appendix A.2. Step-by-Step Explanation

This system of equations investigates whether changes in the creative economy (CRE), information and communication technologies (ICT), and population size (POP) Granger-cause maritime trade (MT). Each equation includes:

- A constant term
- A vector of lagged values (M)
- A residual error term (γ_{it})

The model uses the Toda–Yamamoto approach by adding additional lags (d_{max}) beyond the optimal lag length (k) to ensure that the Granger causality test remains valid even if the variables are non-stationary or cointegrated.

Causality is inferred by testing whether the coefficients of the first k lags of an explanatory variable are statistically significant. For instance, if any of the coefficients θ_{1i} in the MT equation are significantly different from zero, then CRE Granger-causes MT.

Appendix A.3. Definitions of Variables

- MT_t —Maritime Trade: Volume or value of maritime trade flows, typically in billions of USD.
- CRE_t —Creative Economy: Proxy for cultural and creative sectors (e.g., media, arts, advertising), often measured by output or employment in creative industries.
- ICT_t —Information and Communication Technology: Indicator reflecting ICT infrastructure or usage, such as internet penetration, ICT exports, or digital readiness.

- POP_t —Population: Total population size, included to control for demographic scale effects on trade demand and production.
- γ_{it} —Residual term: Captures unexplained shocks in the system not attributed to the included lagged variables.

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