

Research Article

What Is Prospects for Nong Khai Province Through Sino-Thai High-Speed Railway: Lessons Learned from Yunnan

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Abstract

High-speed rail (HSR) has become a significant catalyst for regional economic development and integration, particularly under initiatives such as China's Belt and Road Initiative (BRI). This research investigates the development prospects of Nong Khai Province, Thailand, in terms of border trade facilitated by the Sino-Thai high-speed railway, drawing lessons from the impact of HSR on Yunnan Province, China. The study employs the Analytic Hierarchy Process (AHP) to prioritize key factors influencing border trade development based on insights from experts and senior executives in relevant public and private sector agencies. The findings reveal that infrastructural connectivity is the most critical factor, specifically emphasizing linking transportation systems through rail and land, improving public transport links, and developing digital infrastructure. Reduction of trade restrictions, mainly through streamlined customs procedures and tax reduction measures, is identified as the second most important factor. Human connectivity, including fast passport issuance and enhanced cultural exchanges, ranks third. Financial support mechanisms and policies promoting regional cooperation are also essential for maximizing the benefits of the high-speed rail project. By addressing these factors, Nong Khai Province can effectively leverage the opportunities presented by the Sino-Thai high-speed railway, fostering sustainable economic growth, and enhancing its role as a key player in regional trade. The study provides actionable insights and strategic recommendations for policymakers and stakeholders to optimize the economic potential of Nong Khai through improved connectivity and integration.

Keywords

Sino-Thai High-Speed Railway, Nong Khai Province, Yunnan Province, Analytic Hierarchy Process

1. Introduction

High-speed rail (HSR) has emerged as a transformative force in modern transportation, significantly influencing regional economic development and integration. The expansion of HSR networks, particularly under initiatives like China's Belt and Road Initiative (BRI), presents substantial opportunities for enhancing connectivity, facilitating trade, and

promoting sustainable economic growth. This research focuses on the development of Nong Khai Province in terms of border trade, mainly through the implementation and impact of the Sino-Thai high-speed railway.

Nong Khai Province, located in northeastern Thailand, is a critical gateway for trade between Thailand and its neigh-

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boring countries, especially Laos and China. The strategic position of Nong Khai makes it an ideal case study for examining the potential benefits and challenges associated with developing border trade facilitated by high-speed rail. By leveraging lessons learned from the impact of high-speed rail on Yunnan Province, China, this study aims to provide a comprehensive analysis of the economic and infrastructural implications for Nong Khai. The historical development of HSR in China has demonstrated how enhanced connectivity can lead to significant economic benefits. With its diverse economy and strategic location, Yunnan Province has experienced considerable growth due to the introduction of high-speed rail. Drawing on Yunnan's experience, this research seeks to understand how similar infrastructural advancements can be applied to Nong Khai, identifying key factors that influence border trade development.

This study employs the Analytic Hierarchy Process (AHP) to prioritize the factors influencing border trade development in Nong Khai. The AHP method systematically evaluates complex decision-making criteria, providing a quantitative assessment of the relative importance of various factors. The analysis was based on a survey conducted among experts and senior executives in agencies from public and private sectors, such as Nong Khai Customs House, the provincial commerce department, the Provincial Chamber of Commerce, and transport companies. The results obtained from the AHP decision-making process reveal that infrastructural connectivity, reduction of trade restrictions, connection between people, financial support, and policies promoting regional cooperation are crucial for the development of border trade in Nong Khai Province through the Thai-Laos-China railway linkage under the Belt and Road Initiative. This research highlights the key factors influencing the development of border trade in Nong Khai Province and provides strategic recommendations to maximize the benefits of the Sino-Thai high-speed railway. By addressing these factors, Nong Khai can effectively leverage the opportunities presented by enhanced connectivity, fostering sustainable economic growth and strengthening its role as a key player in regional trade.

2. Literature Review

It is essential to outline the concepts and theories that will guide this study to identify the gaps in existing research and understand the issues that need further investigation. By doing so, we can build a comprehensive framework that highlights the areas lacking in current literature and provides a clear direction for addressing these gaps. The following concepts and theories will serve as the foundation for this research:

1. High-Speed Rail Promotes Regional Economic Development

Regional economics is a sub-discipline that focuses on a particular region's economic conditions and dynamics, including the contribution of economic factors such as industrial structure, labor market, and infrastructure development.

Studying regional economics is important because it can help policymakers and practitioners understand the factors contributing to regional economic growth, development, and success. In recent years, regional economies have been renewed in the spotlight due to the growing interest in location-based policies and strategies that promote regional economic growth and development. Place-based policies address economic inequality by targeting resources and specific regions or areas to promote economic growth and development.

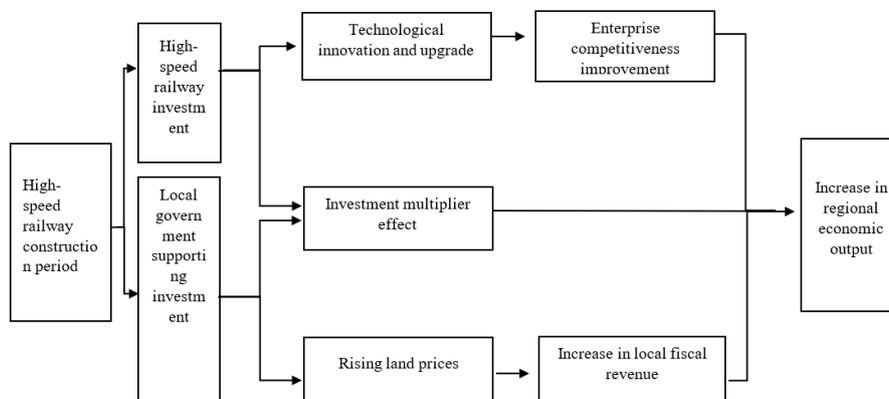
Many researchers who have studied place-based policies and strategies or regional economic development have exchanged views and published many studies. According to a study by Lee and Yoo [9], regional economic development is a complex process involving many factors, including natural resources, infrastructure, human capital, and social networks. They argue that successful regional economic development requires a strategic approach that meets the specifics and challenges of each region. In line with stim et al. [6], successful regional economic development depends on various factors, including institutional capacity, social capital, and the ability to attract and retain talented individuals and businesses. They argue that regional economic development should be viewed as a long-term process that requires sustained investment and commitment.

In comparison, Bristow and Healy [2] emphasize the importance of innovation in regional economic development. They argue that innovative activity is a key driver of economic growth and that successful regional economic development strategies should focus on creating an environment that supports innovation, such as investing in research and development, fostering collaboration between businesses and universities, and promoting entrepreneurship. Another critical aspect of regional economic development is the role of local government and public policy. In their book "Theories of Local Economic Development," Bingham and Robert [1] argue that local government can play a critical role in promoting economic development by creating a favorable business climate, investing in infrastructure, and supporting small businesses and entrepreneurs. Another important aspect of regional economic development is the role of government policies and programs. In their study of regional development in Europe, Dall'erba and Gallo [5] found that government policies, such as investment in infrastructure and support for small businesses, can significantly impact regional economic growth.

The relationship between high-speed rail and regional economies can be divided into two parts [12]: economic drivers during high-speed rail construction and economic forces after high-speed rail construction: during high-speed rail construction, it will act as a regional economic driver. Local governments along the railway line must take various steps to prepare for impacts after the construction is completed, such as optimizing the city plan, defining land acquisition and demolition plans, selecting station locations, establishing investment and financing platforms, industry optimization, and restructuring. When the

construction of high-speed trains began, Local funding flows along railway cities were also mobilized through local policies. The inflow of external capital will be attracted through financing and investment in supporting facilities and improvements to the transport infrastructure. This ultimately translates into local investments in new fixed assets, which has exponentially impacted local economic growth through capital flows; labor mobility

accelerated following the implementation of high-speed rail and subsequent technology flows. In addition, high-speed rail also promotes economic optimization and restructuring of regions, promoting the formation and optimization of the economy. There are growth points along the railway cities and overall economic growth.

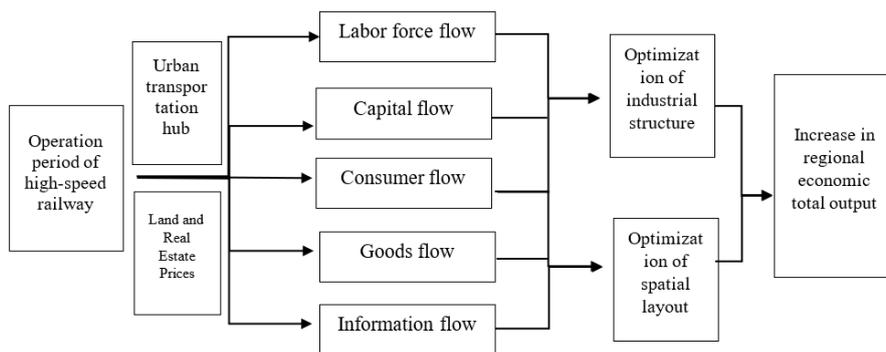


source: Lin [12]

Figure 1. The impact of the high-speed rail construction period on the Regional GDP.

Second is the economic traction behind high-speed rail operations after construction officially started. Some of the investment in high-speed rail contributes directly to the city's gross domestic product (GDP) along the route. In addition, supporting local government investment and construction of supporting facilities will increase the GDP of cities along the railway line. At the same time, with the flow of private capital to build high-speed rail, a new industrial chain is gradually formed, and the city's GDP increases along the way. Procuring products and equipment for the construction of high-speed rail directly places a demand on cities along the route, boosting local economies with exponential impact. The direct demand generated by the construction of high-speed railways has high technical characteristics, promoting the corresponding upgrading of product standards and equipment.

Improve the competitiveness of the organization and ultimately foster local economic growth. We can see an example of the operation of many high-speed rail lines in China that directly affects private and foreign capital flows, capacities, consumption, factors of production, and demand. However, the impact will vary from city to city. Major industrial agglomeration areas will benefit from input diversification, which fosters local GDP growth. However, areas outside these growth points may be affected by input outflows. This can result in consumption stratification, cross-regional flow, and agglomeration, which can negatively affect the service industry in second- and third-tier cities and hinder the growth of local economies. From the above description, we can see the impact of post-construction high-speed rail on the region's GDP in the chart below.



Source: Lin [12]

Figure 2. The impact of the high-speed rail operation period on the Regional GDP.

In summary, high-speed rail significantly impacts the region's economy both during construction and after operation. During the construction, local governments are working to optimize the benefits of high-speed trains and improve transport infrastructure. After opening, the high-speed rail will attract labor and technology, promote efficiency, and lead to economic restructuring and growth in the region.

2. China's Belt and Road Initiative and High-Speed Rail

The Belt and Road initiative (BRI) has actively pushed Chinese business globally by the Chinese president. Most of the high-speed rail projects can mobilize the SOEs for rail and construction, facing a sudden and violent slowdown in the Chinese economy, and one option to react to China's increasing industrial surplus capabilities is the rail project for high-speed. The major promotion of Chinese high-speed rail technology has brought about the establishment of Chinese high-speed rail diplomacy. The BRI participating nations are welcoming to China's high-speed rail diplomacy because of its competitive cost-efficiency ratio and strong impetus in economic and social development. It highlights the Chinese rail network's success as a connection for the Belt and Road Initiative. China's world market leaders have also acquired national importance as symbols of the worldwide industrial competitiveness of China's high-speed transport sector [18]. China's high-speed rail diplomacy is essential to connect the world with China. Connecting China with Southeast Asia is also part of the BRI. China wants to connect southern China with ASEAN countries through high-speed rail projects, especially from Kunming and Nanning to Singapore.

The China-Indo-China Peninsula Economic Corridor by ASEAN has a Master Plan on ASEAN Connectivity [15]. This is a master plan to link ASEAN countries together. Linking the ASEAN countries into the BRI through the high-speed project rail allows ASEAN countries to benefit tremendously from the BRI. China has enormous funds to build a transport route infrastructure connecting China with ASEAN. Moreover, ASEAN is also a region of great importance for China. The Asian Development Bank (ADB) estimates that Asia needs \$ 8 trillion in infrastructure construction investments over the next ten years, and there are currently many projects that China and ASEAN have begun. Construction, such as the Jakarta-Bandung high-speed rail line in Indonesia, has already begun. In addition, China will invest in the Malaysia - China Kuantan industrial estate, the Melaka Gateway Port project, a railway line along the east coast of Malaysia, and a train route from Bangkok to Nong Khai [17]. It can be said that China's foreign policy has continued to influence Mekong countries, especially in neighboring countries such as Myanmar and Lao PDR, where the Lao PDR has accepted concrete international cooperation with China since 1989 [11]. Lao PDR can be considered a neighboring country in Thailand with proximity to the northeast in geography, language, culture, and kinship. In addition, the two countries again had an active international

academic cooperation in the early 1990s, and now the Lao PDR is very open to cooperation between China in terms of trade and investment.

China is considered a significant donor to the Lao PDR [19]. When China's BRI was initiated, high-speed rail construction was built in Lao PDR by connecting the construction of a high-speed rail to Nong Khai, Thailand. This phenomenon affects many sectors, especially in the large provinces in the northeast, such as Nong Khai, Udon Thani, and Khon Kaen [13]. This is consistent with Kurlantzick's [8] comments that BRI's cooperation with ASEAN countries through the high-speed rail program is one of the most prioritized infrastructure development regions. This can be seen from the opening a high-speed train route from Kunming to Lao PDR, which the Lao PDR government expects to achieve economic growth in Lao PDR, a landlocked country. Freeman [7] states that the railway line in the Lao PDR requires the construction of a new bridge over the Mekong River.

In addition, Ratimakchanan [14] suggested that Thailand should find ways to increase export value from the BRI, especially the BRI line that runs across the area, contributing to urban development—causing many markets to support Thai export products. In addition, the former Transport Minister insisted that the development of the Bangkok-Nong Khai high-speed rail route would benefit the economic development in the region, especially by creating opportunities through access to infrastructure. If it can be opened for service by 2021, it will contribute to economic growth for the cities along the railway line, approximately 11.68%. Moreover, when the Bangkok-Nong Khai route is opened, 13.52% of the overall economic benefit will be generated [16]. The development of rail systems to connect regions is the economic and social development distribution.

Furthermore, when the network is complete, Thailand will become Southeast Asia's transportation and transportation hub, which will have a comprehensive economic impact on each city. Charassangsomboon [3] added that Thailand is not directly on the BRI line, both land and sea. This is reflected in the determination of the link between the People's Republic of China and the Indochina region as one of the six economic corridors under the BRI initiative, named the China-Indochina Peninsula Economic Corridor through transport routes in line with the BRI related to Thailand are Bangkok-Nong Khai high-speed rail system project. Li [10] highlights that Thailand is located in the heart of ASEAN. It is both a center for export and traveling to other countries in the ASEAN region quickly, saving cost and time, and the Thai infrastructure system is quite good, making Thailand a vital investment destination in ASEAN. Chareon [4] also noted the benefits of building a high-speed train between Thailand and China under the BRI framework, which is considered an opportunity and mutual benefit between Thailand and China. To enable Thailand to expand export opportunities, especially agricultural products and food processing, to China and the

countries along the route through high-speed rail or modern transport networks both by land and sea. These things will affect the future economic growth between Thailand and China. In the short term, joining the BRI, especially in the construction of high-speed rail, will enable Thailand to significantly expand its trade volume with China and ASEAN due to geographic proximity. Expanding trade volumes with other countries along BRI routes will likely occur in the medium to long term. This is because it takes time to establish concrete connections between Thailand and these countries. Considering the opening of new trade markets for Thailand, the BRI initiative can significantly benefit by providing increased access to new markets, especially in regions with relatively low export volumes from Thailand today, such as the other States of the CIS and Central Asia regions.

The literature reviews indicate that Thailand's regional economy might benefit significantly from the high-speed rail strategy. Thailand must expedite its development efforts to capitalize on these opportunities, particularly those arising from the BRI. This paper examines the development prospects in Nong Khai Province, Thailand, through the Sino-Thai high-speed railway, drawing lessons from the impact of high-speed rail on Yunnan Province, China. By analyzing the historical development of high-speed rail in China and its economic effects on Yunnan, this study provides insights into the potential benefits and challenges for Nong Khai.

3. Planning of the Sino-Thai High-Speed Railway

The Sino-Thai high-speed rail project is a crucial component of China's Belt and Road Initiative, a vast infrastructure development project spanning multiple continents. The initiative aims to create a trade and transportation infrastructure network connecting China with Southeast Asia, Europe, and Africa. The high-speed rail project, which will link Kunming, the capital of China's Yunnan Province, with Bangkok, Thailand's capital, is a critical piece of this network. Connecting with other countries across Asia is expected to bring significant economic benefits to the region. Thailand's participation in the project is a valuable opportunity to improve its transportation infrastructure and expand its economic growth potential. The project's development has been a long process, with negotiations between the two countries dating back to the early 2000s, reflecting the significant complexity and importance of the initiative.

The project has been in development for several years, with both countries signing a Memorandum of Understanding (MOU) in 2010 to initiate the project. However, progress has been hindered by various setbacks. It was not until May 12, 2016, when the Thai-Chinese government signed and certified the minutes of the joint committee meeting for the 10th Thai-Chinese railway cooperation in Beijing, that both sides agreed to build a railway line connecting Bangkok and Na-

khon Ratchasima jointly. Subsequently, on July 11, 2017, the Cabinet approved that the State Railway of Thailand implement a project to develop high-speed trains to connect the Bangkok-Nong Khai route by first developing the Bangkok-Nakhon Ratchasima period. The high-speed rail line will stretch for more than 608 kilometers, with a track gauge of 1.435 meters, consisting of two phases. The first phase will connect Bangkok with Nakhon Ratchasima through the Bangkok-Nakhon Ratchasima route project, using technology in design, construction, and the railway system of China. The Thai government will utilize an investment budget of 179,412.21 million baht to fund the project, which will begin at Bang Sue Central Station and end at the Nakhon Ratchasima terminal station, totaling six stations with a distance of 250 kilometers. The project's structure will consist of 188 kilometers of elevated roads, 54 kilometers of ground level, and 8 kilometers of tunnels. The tunnel will be used to cut through the mountainous area to shorten the distance, in which there will be two tunnels along this route.



Source: CGTN

Figure 3. Sino-Thai high-speed railway.

The second phase of the high-speed train project will connect Nakhon Ratchasima and Nong Khai, spanning 357 kilometers. This route, known as the "Thai-China high-speed train phase 2," will connect Thailand's trade and investment with Lao PDR and the People's Republic of China. The environmental impact assessment report for this route has al-

ready been presented. The project aims to promote domestic and international tourism and boost international trade. The proposed high-speed train route is strategically important for Thailand as it will facilitate better connectivity and trade relations with neighboring countries. It will also serve as a vital link between the economies of Southeast Asia and China. The project is expected to open after the high-speed train from Bangkok to Nakhon Ratchasima has been in operation for about 3-4 years, around 2029-2030. The route will have six stations, including Nakhon Ratchasima Station, Bua Yai Station, Ban Phai Station, Khon Kaen Station, Udon Thani Station, and Nong Khai Station. The train will then cross the Mekong River into Laos and pass through the Lao provinces of Vientiane and Luang Prabang before crossing the border into China and ending in Kunming.

In 2020, an announcement was made that the Fuxing Hao CR300AF, a high-speed train manufactured by China Railway Construction Corporation (CRCC), would be utilized in Thailand's high-speed rail network as part of a joint venture between China and Thailand. Specifically, the Fuxing Hao CR300AF will operate on the Bangkok-Nong Khai high-speed rail line, a strategic route connecting Thailand's trade and investment with Lao PDR and the People's Republic of China. This marks the first time the Fuxing Hao CR300AF will be used outside China. The Fuxing Hao CR300AF is designed to have a service life of 30 years. It comprises eight carriages in one train, divided into two Business Class carriages, four Standard Class carriages, one non-amenity carriage, and one dining carriage. The train has 594 seats, with 96 seats in First Class and 498 seats in Standard Class. Using electric propulsion, the Fuxing Hao CR300AF can reach up to 250 km/h and features a streamlined design that allows maximum performance and reduced air resistance.

Additionally, the Fuxing Hao CR300AF has advanced safety features, such as automatic train protection and collision avoidance systems, to ensure the maximum safety of passengers. One of the unique features of the Fuxing Hao CR300AF is its advanced energy-saving technology. The train uses regenerative braking, which enables energy recovery during braking and recycles it to increase train power. This technology reduces energy consumption and improves the overall efficiency of the train.

However, the construction of the Thai-Chinese high-speed rail project has only sometimes been smooth sailing; it has faced numerous challenges and experienced significant delays. It underwent a lengthy screening process involving multiple governments before the administration of Prime Minister General Prayut Chan-o-cha initiated construction. Discussions regarding the investment proportion between China and Thailand proved challenging to settle, causing further delays. Eventually, a decision was reached for Thailand to invest 100% in civil works while China would handle the design and installation of electrical and mechanical systems. Construction began in December 2017 for Phase 1, but

land expropriation problems and contract legal disputes hampered progress. The COVID-19 pandemic further impacted construction by limiting the movement of workers due to lockdowns. However, many of these obstacles have been resolved over time. Thai contractors have gained expertise, and advanced technology has been employed, aided by a royal decree that facilitated land expropriation. Negotiations with encroachers led to their voluntary relocation. As a result, Phase 1 has reached 13% completion and is expected to open in 2026.

4. Case Study on the Impact of High-Speed Rail on Yunnan

The selection of the Yunnan High-Speed Rail (HSR) case study for analyzing the potential impact of the Thailand HSR project is influenced by several factors. Firstly, Yunnan's geographical location and socioeconomic characteristics may bear similarities to the regions along the proposed Thailand HSR route. For example, both Yunnan and specific areas in Thailand might have comparable economic development, population density, or infrastructural needs. Secondly, Yunnan's HSR might be a strategic model for promoting regional economic growth through enhanced connectivity and transportation infrastructure. If the objectives of the Thailand HSR project align closely with those of the Yunnan HSR, studying the latter could provide valuable lessons and benchmarks. Finally, the findings from studying Yunnan's HSR could have direct policy implications for Thailand's HSR project. Suppose the outcomes, challenges, or success factors identified in Yunnan are relevant to the context of Thailand. In that case, policymakers and stakeholders involved in the Thailand HSR initiative may find the case study informative and actionable.

This section uses quantitative data to analyze the true impact of high-speed rail construction and opening-up on the gross economic growth increase of the four cities connected by the high-speed rail lines that pass through Yunnan province, specifically the Shanghai-Kunming and Kunming-Nanning lines. Future economic impact assessment is necessary, and these need to cover various factors such as GDP growth, GDP growth per capita, industry structure, and the volume of passenger and cargo transportation.

4.1. The Impact of High-Speed Rail on Yunnan's Economy

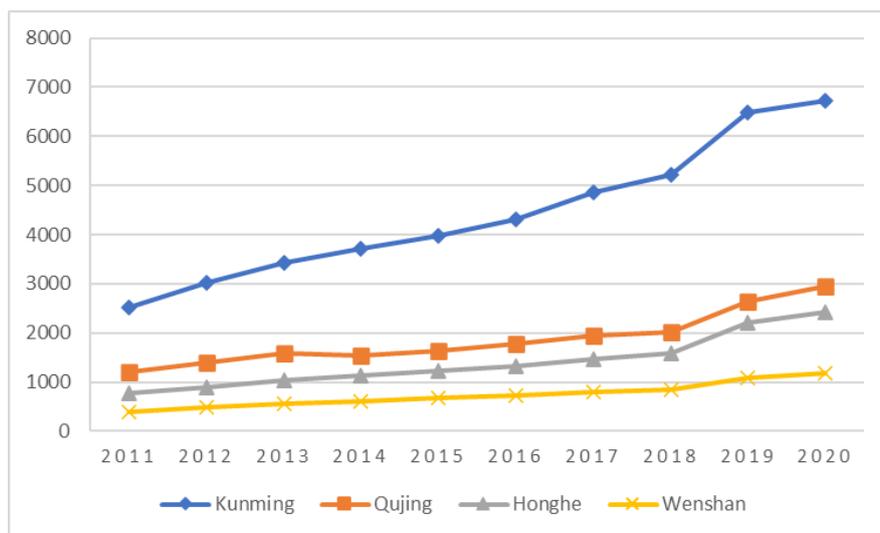
According to the 14th Five-Year Plan for China's National Economic and Social Development (2021-2025), Yunnan province is a vital component of this plan, with several high-speed rail lines currently under construction or in the planning process. The construction of the Yunnan high-speed railway began on February 27, 2009, and the first provincial high-speed railway commenced operations on December 28, 2016. The impact of these rail lines on the region's economy

is evident when considering the GDP of the four major cities in Yunnan: Kunming, Qujing, Wenshan, and Honghe, all of which are served by high-speed rail. Notably, the size of these four cities' GDP has almost tripled in a decade. As of 2020, Kunming ranked first in GDP at 673.379 billion yuan, followed by Qujing in second place. Honghe took third place with a GDP of 241.748 billion yuan, while Wenshan ranked fourth with a GDP of 118.512 billion yuan.

Based on the economic data, Kunming has the most significant gross domestic product (GDP) among the four cities in Yunnan province. Kunming's GDP is greater than the cumulative GDP of the other three cities, namely Qujing, Honghe, and Wenshan. As the capital city of Yunnan, Kunming plays a central role in politics, culture, and economy, contributing to most of the province's total GDP. The development of high-speed rail in Yunnan has brought signifi-

cant economic benefits to the province. Since opening the first high-speed railway line in 2016, the four cities in Yunnan have experienced varying degrees of GDP growth. Kunming's GDP growth rate was 13%, 7%, and 24% in the three years following the opening of the high-speed railway. During the same period, Qujing's GDP growth rate was 10%, 4%, and 31%, and Honghe's GDP growth rate was 11%, 8%, and 39%.

Meanwhile, Wenshan's GDP growth rate was 10%, 6%, and 26%. It is worth noting that the high-speed railway network has played a significant role in promoting economic development in Yunnan province. To better understand the impact of high-speed rail on the regional economies of Yunnan province, the figure and table below provide a detailed overview of the GDP growth rates of the four cities in the province.



Source: China's National Bureau of statistics

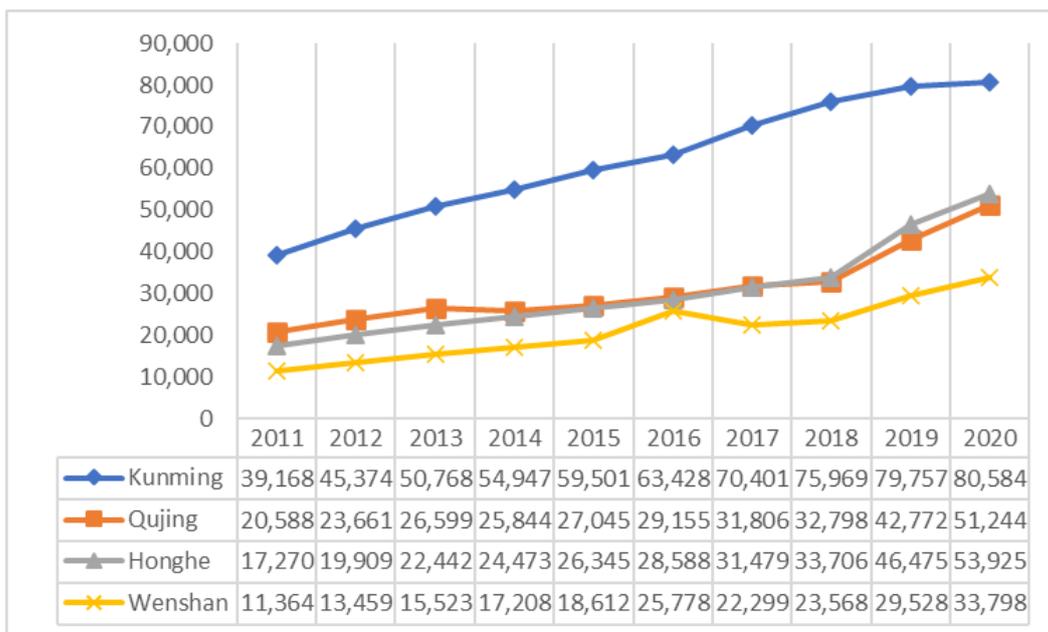
Figure 4. GDP of cities along the high-speed rail line in Yunnan (Unit: 100 million yuan).

From Figure 5, which illustrates the GDP per capita of cities along the high-speed rail line in Yunnan Province from 2011 to 2020, it is evident that the GDP per capita of Kunming, Qujing, Wenshan, and Honghe increased almost threefold within nine years. In 2020, Kunming topped the list with a GDP per capita of 80,584 yuan, followed by Qujing with 51,244 yuan, Honghe with 53,925 yuan, and Wenshan with a GDP per capita of 33,798 yuan. If we delve into the GDP per capita growth rate in the three years since the first high-speed railway opened in 2016, we can observe that Kunming had a growth rate of 8%, 9%, and 3%, respectively, from 2016 to 2018. Qujing, on the other hand, had a growth rate of 9%, 10%, and 7% respectively from 2016 to 2018. Honghe's GDP per capita increased by 9%, 10%, and 7%, respectively, from 2016 to 2018.

Meanwhile, Wenshan had a GDP per capita growth rate of 39%, -13%, and 6% respectively from 2016 to 2018. The construction of high-speed rail in Yunnan Province has signif-

icantly impacted the region's economic development. One of the most prominent benefits is the creation of numerous job opportunities. The construction of high-speed rail requires substantial labor and material, providing income to local workers and businesses. This has helped boost the local economy and stimulated economic growth in neighboring areas.

Moreover, the high-speed rail network positively impacts the cities' GDP per capita. With increased transportation capacity, businesses have been encouraged to invest in the region, leading to the growth of various industries. The improved transportation efficiency has also facilitated the transportation of goods, making it easier for businesses to expand their operations. As a result, the high-speed rail network has been a catalyst for economic growth and development.



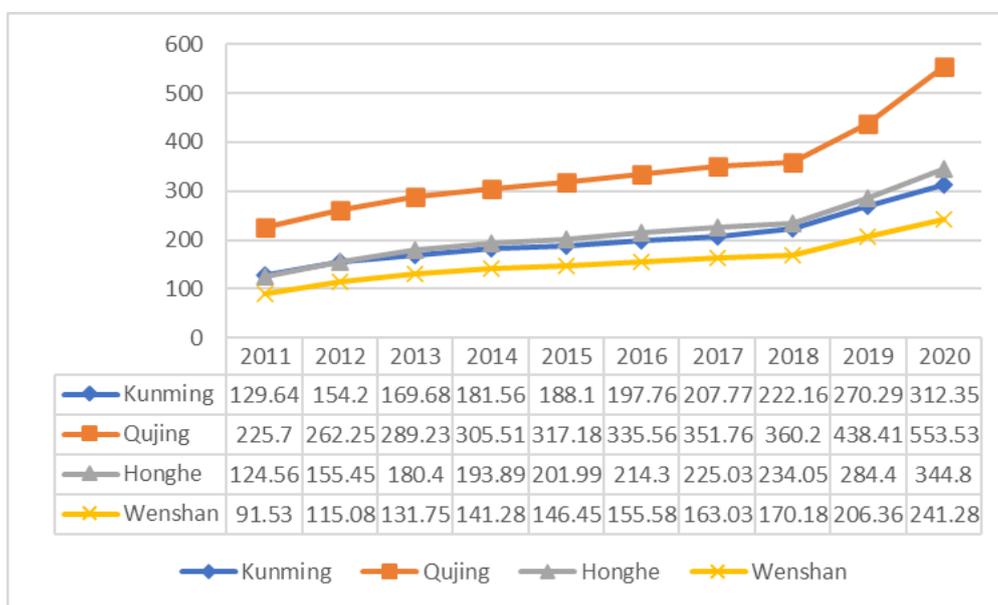
Source: China's National Bureau of statistics

Figure 5. GDP per capita of cities along the high-speed rail line in Yunnan (Unit: 100 million yuan).

4.2. The Impact of High-Speed Rail on Yunnan's Industrial Structure

Implementing high-speed rail has profoundly impacted the regional economy and industrial structure of Yunnan Province, situated in southwestern China, which has witnessed significant economic development in recent years. As one of the key factors driving this growth, high-speed rail is trans-

forming the landscape of the province's cities. The construction of high-speed railways has contributed to a steady rise in the share of primary production in four cities of Yunnan Province between 2011 and 2016, as shown in Figure 6 below. Moreover, the share of primary production could nearly double after the high-speed railway was built from 2016 to 2020. Primary production has the highest added value of 65%, making it a crucial contributor to the province's economy.

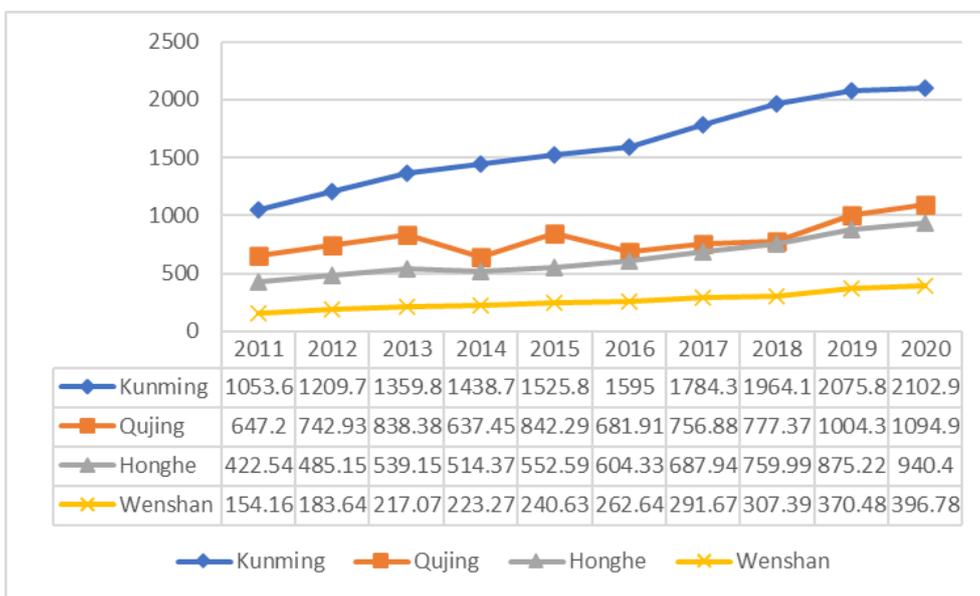


Source: China's National Bureau of statistics

Figure 6. The value of primary industries in the cities along the high-speed rail line in Yunnan (Units: 100million yuan).

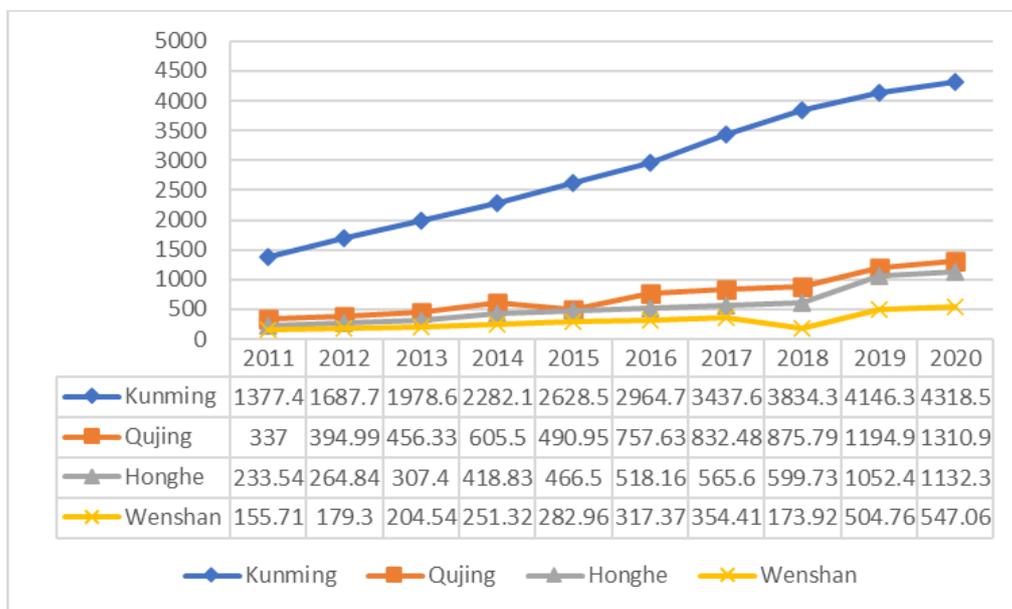
Figure 7 describes the growth rate of secondary industries in four cities in Yunnan Province, Kunming, Honghe, Wenshan, and Qujing, and how high-speed rail has influenced their industrial sectors. The past decade has witnessed strong growth in Kunming, Honghe, and Wenshan secondary industries, with an average annual growth rate ranging from 8.1% to 9.9%. This solid growth rate indicates that these cities' industrial sectors are expanding rapidly due to the positive

influence of high-speed rail. It also highlights the success of these cities in promoting their respective industries and attracting investment. On the other hand, Qujing is growing at a moderate pace, with an average annual growth rate of 5.6%. Several factors could contribute to this slower growth pace, such as Qujing's relatively smaller size than Kunming or differences in the industrial structure of the two cities.



Source: China's National Bureau of statistics

Figure 7. The value of secondary industries in cities along the high-speed rail line in Yunnan (Units: 100million yuan).



Source: China's National Bureau of statistics

Figure 8. The value of tertiary industries in cities along the high-speed rail line in Yunnan (Units: 100 million yuan).

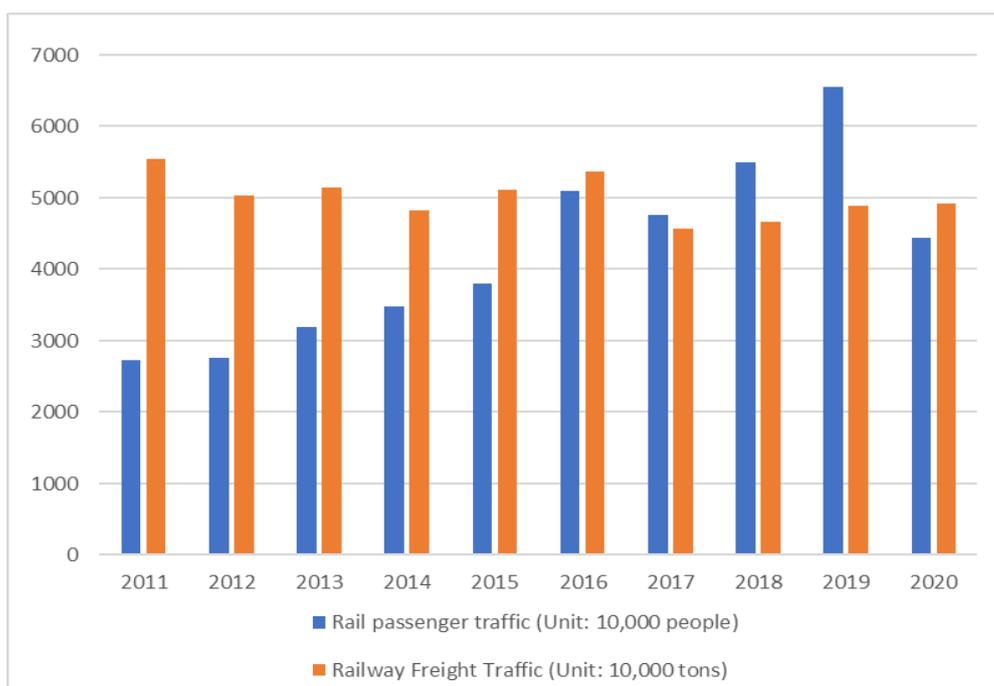
Figure 8 discusses the tertiary industry, its importance in modern economies, and the impact of high-speed rail on the growth rate of tertiary industries in Yunnan Province. The tertiary industry encompasses various economic activities, such as transportation, retail, healthcare, education, and hospitality. It is vital in most modern economies, including China and Yunnan. It creates job opportunities and contributes to economic growth. The impact of high-speed rail on the growth rate of tertiary industries in Yunnan Province can be seen in the relatively stable growth rates of Kunming, Honghe, and Wenshan. The average annual growth rates before high-speed rail construction in 2016 were 18%, 19%, and 16%, respectively. After the construction of high-speed rail, the growth rates were 10%, 22%, and 34%, respectively, indicating the positive impact of high-speed rail on the growth of tertiary industries in these cities. In Qujing, however, the growth rate of the tertiary industry fluctuated wildly before the high-speed railway was built. From a decrease of 19% in 2015 to an increase of over 54% in 2016, the growth rate continued to fluctuate and reached 36.12% in 2019. Nevertheless, it is worth noting that the growth rate of the tertiary industry in Qujing was relatively stable and higher after the high-speed railway construction than before.

Therefore, before the construction of high-speed rail in Yunnan Province, the total value of primary, secondary, and tertiary industries in Kunming, Qujing, Honghe, and Wenshan along the four-city route was 57.1 billion yuan, 227.7 billion yuan, and 210.4 billion yuan, respectively, with the three-industry structure ratio at 11.54: 45.99: 42.48. The relatively high proportion of secondary industries was due to the development of heavy industries in these regions, such as mining and manufacturing. However, the lack of transportation infrastructure hindered further economic development in the region. After the high-speed railway construction in 2020, the total value of primary, secondary, and tertiary industries along the route increased significantly to 145.2 billion yuan, 453.5 billion yuan, and 730.9 billion yuan, respectively. The proportion of the three-industry structures changed to 10.92: 34.11: 54.97. It indicates that the tertiary industry has become the dominant sector, which has led to the development of the service industry in these regions. This growth is attributed mainly to the significant reduction in transportation costs, as high-speed rail has improved the accessibility of markets and increased the mobility of people and goods in the region. Consequently, more investments and industries have been attracted to these regions, leading to the development of the

entire region's economy.

4.3. The Impact of High-Speed Rail on Yunnan's Passenger and Freight Traffic

Based on the provided information, it is clear that the completion of the high-speed rail project in 2016 had a significant impact on rail passenger traffic in Yunnan Province. Before the project was completed, rail passenger traffic steadily increased, with a CAGR of around 5.5%, from 2011 to 2015. However, in 2016, rail passenger traffic surged sharply by approximately 68.4% year-on-year, from 3,800 to 5,100 (10,000 per unit). This substantial increase indicates that the high-speed rail project positively impacted rail passenger traffic. Although there was a slight decrease in rail passenger volume in 2017 to 4,753.51, it was still higher than in 2016. From 2018 to 2019, rail passenger traffic continued to grow steadily, with a CAGR of about 8.4% from 2016 to 2019, indicating a sustained positive effect of high-speed rail on rail passenger traffic. However, in 2020, rail passenger traffic saw a significant decline of about 32.2% compared to the previous year, which can be attributed to the travel restrictions and lockdowns imposed to curb the spread of COVID-19. Despite impressive passenger statistics, the rail freight situation in Yunnan Province has been generally volatile, according to available data in Figure 9. The year-on-year growth rate of rail freight traffic has fluctuated over the years, with periods of growth, such as between 2014 and 2016, when the growth rate was about 5%, and periods of decline, such as between 2011 and 2012 and 2016 and 2017, when the growth rate was negative. Overall, the rail freight traffic growth rate appears modest and may have fluctuated over the past decade with no apparent long-term trend. It is worth noting that the spread of COVID-19 could have impacted cargo traffic in 2020, and it may take some time to understand the pandemic's impact on transportation and logistics fully. The rail industry in Yunnan Province may have been affected by supply chain disruptions, reduced demand for certain goods, and restrictions on movement and trade. Overall, it is clear that high-speed rail has had a significant impact on the transportation industry in Yunnan Province, particularly in the area of passenger traffic. However, the rail freight industry has not experienced the same success and faces ongoing challenges, particularly in light of the pandemic's impact.



Source: China's National Bureau of statistics

Figure 9. The passenger and freight traffic in Yunnan Province (Units: 10,000 people for passenger traffic and 10,000tons for cargo traffic).

In summary, developing high-speed rail infrastructure in Yunnan has created numerous job opportunities, stimulated economic growth, and positively impacted the GDP per capita of these cities. Furthermore, the construction of high-speed rail in Yunnan Province has significantly influenced the region's industrial structure and transportation system. The researcher will consider these factors when evaluating the potential impacts on Thailand's regional economy from the construction of high-speed rail in the following chapter. However, it is essential to note that while valuable lessons can be learned from Yunnan's experience, applying all aspects directly to Thailand may not be feasible due to differing contexts. For instance, differences in land ownership laws in Thailand can affect the cost of high-speed rail construction, and the political and administrative context may introduce potential delays.

5. Methodology

In this research, AHP is employed to prioritize the factors that influence the development of Nong Khai Province through the Sino-Thai high-speed railway. The Analytic Hierarchy Process (AHP) is a structured technique for organizing and analyzing complex decisions based on mathematics and psychology. It allows decision-makers to model a problem in a hierarchical structure, decompose it into a set of criteria and sub-criteria, and assign numerical values to subjective assessments of the relative importance of each criterion. This quantitative approach facilitates the comparison of various elements and the prioritization of actions or strategies. By applying the AHP method in this research, we can sys-

tematically evaluate and prioritize the factors influencing the development of Nong Khai Province through the Sino-Thai high-speed railway. This approach enhances the decision-making process and provides clear insights into the areas that require focused efforts to maximize the economic benefits of the high-speed rail project.

This research focuses on the development of Nong Khai Province in terms of border trade, mainly through the implementation and impact of the Sino-Thai high-speed railway. This method consists of five steps for the research procedures or methods: data collection, determination of factors used as criteria, preparation of the AHP questionnaire, data collection and summarization of survey data from the AHP questionnaire, and discussion of results and conclusions. The following are the steps to proceed:

5.1. Data Collection

This qualitative research study explores the prospects for developing border trade in Nong Khai Province facilitated by the China-Thailand high-speed railway. The data for this study was obtained through interviews conducted with a carefully selected group of experts and senior executives in the region. Nong Khai was chosen as the pilot province for this research due to its rail connection with the Laos-China high-speed train. The key informants, subject matter experts with substantial work experience in border trade development, were selected using purposive sampling from relevant public and private agencies. The sample group consisted of Nong Khai Customs House representatives, the provincial commerce department, and the Provincial Chamber of Commerce.

These key informants were chosen based on their work experience ranging from 10 to 25 years in the business sector, specifically focusing on the border areas of Nong Khai Province. Furthermore, the study included entrepreneurs

operating in the border regions of Nong Khai Province and transport companies with a minimum of 10 years of experience. The positions and agencies represented in the sample group are as follows:

Table 1. The sample of the respondents.

| No. | position | Organization |
|-----|--|--|
| 1. | Nong Khai Provincial Commerce | provincial commerce |
| 2. | Director of Customs Services | provincial customs |
| 3. | Vice President of the Chamber of Commerce | Nong Khai Chamber of Commerce |
| 4. | Mayor | Department of Local Administration |
| 5. | Nong Khai Railway Station Master | State Railway of Thailand |
| 6. | Head of Investment Service Center in Special Economic Development Zone, Nong Khai Province | Nong Khai Provincial Planning and Development Unit |
| 7. | Specialist Policy and Planning Analyst | Nong Khai Provincial Planning and Development Unit |
| 8. | International Trade Scholar | Mae Fah Luang University |
| 9. | construction material shop operator | Sompong Home Plus Co., Ltd. |
| 10. | Logistics Customer Service Manager | YONG AN LOGISTICS CO., LTD. |
| 11. | real estate broker | No agency |
| 12. | retail store operator | Tesco Lotus Express - Convenience Store |

5.2. Determination of Factors Used in Selection as Criteria

5.2.1. Determining Selection Criteria

The determination of factors for selection as criteria were obtained from a review of literature related to the BRI under the concept of Five Harmonies, as well as studying factors affecting the development of border trade in Nong Khai Province by the China-Thailand high-speed railway. This was done by applying the AHP method. The main criteria and sub-criteria can be summarized in [Table 2](#) and [Table 3](#) below.

Table 2. Main criteria of factors affecting the development of border trade.

| Main Criteria | Definition |
|--|--|
| (E1) Policy for promoting regional cooperation | Cooperation between the government and private sectors is promoted by formulating strategies and economic development measures, jointly formulating a plan to promote regional cooperation, negotiating and solving problems, building a communication mechanism, and exchanging benefits. The promotion of mutual trust is also emphasized. |
| (E2) Infrastructures connectivity | Promote cooperation in connection with facility and infrastructure improvement and construction and establish a standardized technology system, including various communication networks. |
| (E3) Reduction of Trade restrictions | Investment and trade facilitation problems have been solved, including eliminating trade restrictions and barriers. Appropriate trade and investment laws are in place, creating an atmosphere conducive to trade and investment. |
| (E4) Financial support | Deep financial cooperation has been promoted, focusing on building a stable monetary system, credit information system, and local investment and finance system. |
| (E5) Connection between the people | Efforts have been made to foster a strong relationship between the people, promoting nationally friendly cooperation along the China-Laos-Thailand high-speed railway line. This includes promoting cultural, artistic, personnel, academic, and educational exchanges and cooperation in exchanging and linking various information. |

Table 3. Sub-criteria of factors affecting the development of border trade.

| Sub-Criteria | Definition |
|--|--|
| E1 Policy for promoting regional cooperation | |
| (S1.1) Thailand-Laos-China Cooperation Framework | Cooperation between the public and private sectors is established to formulate strategic plans and economic measures to promote regional cooperation. |
| (S1.2) Promote international business matching | The activity/plan/project is focused on developing and promoting international border trade, with an emphasis on promoting international business matching. |
| (S1.3) SME Support Policy (Local Business) | A policy is implemented to enhance the potential of SMEs, enabling them to adapt to the new economic context, compete effectively, and improve product branding. Additionally, efforts are made to upgrade product standards and enhance product processing. |
| (E2) Infrastructures connectivity | |
| (S2.1) Linking the transportation system through the border by rail and land | The linkage of rail and land transportation systems facilitates the import-export of goods and serves as a product transfer center. It also streamlines the handling of formalities between countries that border the exporter or a third country. |
| (S2.2) Connecting digital infrastructure | Information technology infrastructure is connected to facilitate digital technology utilization in business operations and logistics activities. |
| (S2.3) Improving public transport links within the area | Public transport connections, including cars, rails, and boats, ensure smooth and comfortable travel between locations. |
| (E3) Reduction of Trade restrictions | |
| (S3.1) Fast and convenient customs clearance | Operational procedures for exporting and importing goods are improved to ensure accuracy, completeness, and efficiency. |
| (S3.2) Implement measures to reduce tax rates | Measures are implemented to reduce taxes and fees, supporting business operations within border economic zones. |
| (S3.3) Investment promotion measures | Measures are in place to incentivize and promote both foreign and domestic investment. |
| (E4) Financial support | |
| (S4.1) Financial support funds | The International Monetary Fund plays a role in supporting international financial cooperation along the high-speed rail route. |
| (S4.2) Foreign currency exchange | The Exchange of Thai Baht against the Yuan or Kip is regulated with measures to control the exchange rate, ensuring suitability for current economic conditions. |
| (S4.3) Efficient and secure payment system | A payment system is established to support commercial and financial activities, facilitating smooth and secure payment transactions. |
| (E5) Connection between the people | |
| (S5.1) Raising labor standards in the area | Skill development programs are promoted to enhance the language proficiency of local workers, specifically in Chinese and Vietnamese, to support trade, investment, and tourism activities. |
| (S5.2) Control transnational infectious diseases | Strong legal measures are implemented to surveil, prevent, and control contagious diseases within the area. |
| (S5.3) Enhance cultural exchange | Cultural knowledge exchange initiatives are encouraged to foster mutual understanding and support trade, investment, and tourism. |
| (S5.4) Fast passport issuance process | Efficient and streamlined procedures are implemented to obtain passport certification documents for travelers quickly and effectively. |

5.2.2. Defining a Decision-Making Structure

By dividing the decision-making structure into hierarchies, which consisting of Level 1 structure: Goals for the development of border trade, which represents the top level of the analytical hierarchy; Level 2 structure: Criteria comprising factors that influence the development of border trade in Nong Khai Province; Level 3 structure: Sub-criteria serving as guidelines for the successful and sustainable development of border trade in Nong Khai Province.

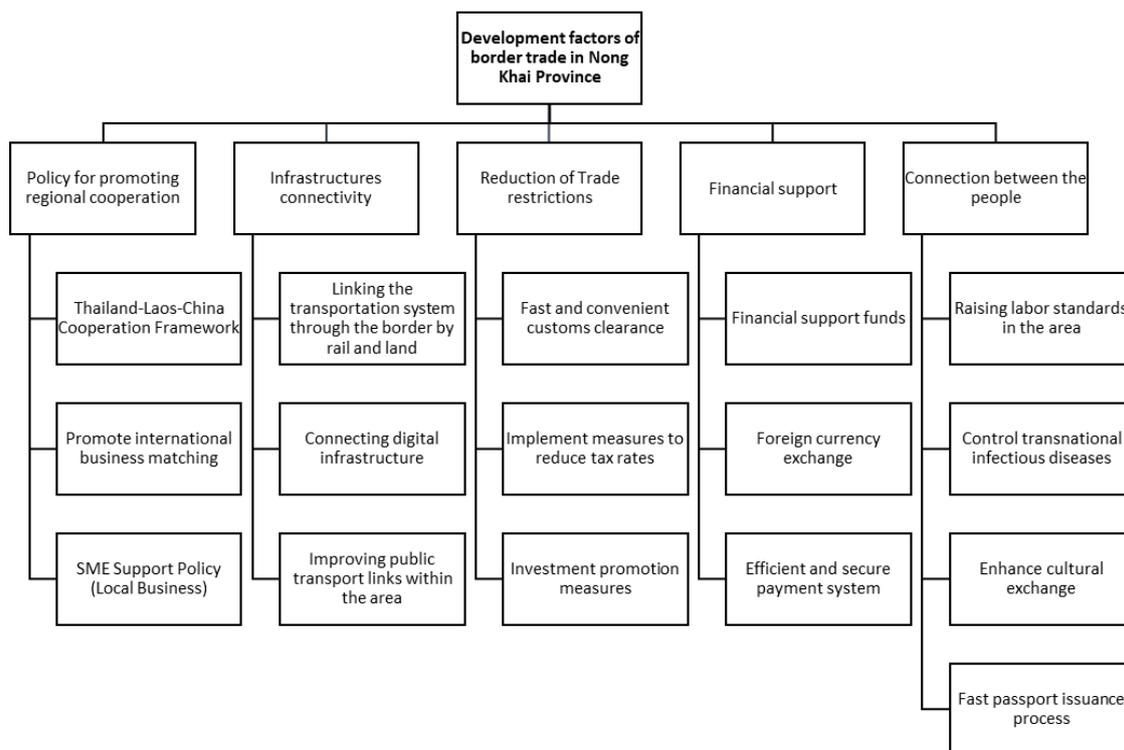


Figure 10. AHP model about prioritizing factors and expectations.

5.3. Preparation of the AHP Questionnaire

After obtaining the main criteria and sub-criteria used to prioritize the factors influencing border trade development in Nong Khai Province through the Thai-Laos-China high-speed train, a questionnaire was designed to gather opinions from samples and experts. The questionnaire includes the following details: Part 1: Information of respondents; Part 2: Methods for answering the questionnaire and explanations of the meaning of each factor; Part 3: Comparison of factors likely to contribute to the development of border trade in Nong Khai Province and the Thai-Laos-China railway connection; Part 4: Comparison of the importance of secondary factors that tend to promote the development of border trade in Nong Khai Province and the Thai-Laos-China railway linkage.

5.4. Data Collection and Summary of Survey Results from the AHP Questionnaire

This research will apply the proposed model, which is based on the theory of Thomas Saaty. Data will be collected from experts or agencies related to border trade in Nong Khai Province. The collected data will be used to create an interview form for experts, who will select the factors with the highest scores. The following steps will be taken to collect the data and summarize the results: Step 1: Introduction and clarification of information. This step involves interviewing a

sample group and experts to present data and models. It also explains the theory of AHP (Analytic Hierarchy Process), the meaning of fundamental measurements, and assessment methods. Examples of assessments will be provided for consideration to prevent deviations from the assessment. The expected research results will also be communicated, including answering any questions; Step 2: Data Collection via Expert Interview Form. Data is collected through pairwise comparative judgment interviews with each assessor using an expert interview form. This form is initially located at the bottom of the hierarchical structure. Then, the interview form is filled out for the hierarchy levels above, respectively. In other words, the assessors compare the sub-criteria at level three and then compare each key criterion at the second level. Once the appraisers have compared all the sub-criteria pairs, they compare the main criterion at Tier Two with the target at Tier One. This process helps prioritize the expectation factors for developing border trade in Nong Khai Province by the Thai high-speed rail, Laos, and China; Step 3: Checking the Consistency of Judgments from the Expert Interview Form. The researcher took the judgment data obtained from the expert interview form and entered it into the Expert Choice program to verify the consistency of each assessor’s judgment. This process provides a consistent value for each expert’s judgment when considering different problems in the same environment. The AHP method will be used to compare pairs during this analysis. The information acquired will align with the individual’s discretion as they assess each item. While the AHP does not require expert judgment to be entirely con-

sistent, a general rule is that if the level of consistency in each judgment is below 10%, the data set is considered reliable or acceptable; Step 4: Adjustment of discretion. After checking the consistency of the results obtained by the experts, it was found that specific criteria did not meet the required standards. As a result, the researcher scheduled meetings with the assessors to review these criteria. This process will be carried out simultaneously with the adjustments made directly through the Expert Choice program, allowing for immediate result modifications.

From the above methodology, the findings will demonstrate that the diagnosis aligns with the reasons, which is considered acceptable and aids in explaining the significance of importance. Furthermore, prioritization of each factor can be achieved by analyzing their respective weights.

6. Main Findings

6.1. Lessons from Yunnan and Applications to Thailand

High-speed rail (HSR) is a transformative infrastructure project that can significantly enhance regional economic development by improving connectivity, reducing travel time, and facilitating the movement of goods and people. The case study of Yunnan Province in China illustrates the profound impact that HSR can have on local economies. However, it is essential to recognize that HSR is only one of many factors influencing regional economic development. Furthermore, differences in national contexts, such as those between China and Thailand, must be considered when analyzing the potential impact of HSR in different countries.

6.1.1. Economic Impact of High-Speed Rail in Yunnan

The construction of HSR in Yunnan, exemplified by the Shanghai-Kunming and Kunming-Nanning lines, has significantly promoted local economic development. Key cities such as Kunming, Qujing, Honghe, and Wenshan have experienced substantial GDP growth, enhanced industrial development, and improved transportation efficiency. Yunnan's diversified economy, which includes agriculture, manufacturing, tourism, and rich natural resources, has benefited from the improved connectivity and reduced travel times provided by HSR. Quantitative data shows that introducing HSR has increased Yunnan's investment, job creation, and economic growth. For instance, Kunming's GDP nearly tripled within a decade following the HSR development, highlighting the positive economic impact of enhanced transportation infrastructure. The HSR network has also facilitated the growth of industries such as tourism, manufacturing, and services, contributing to the overall economic progress of the province. The development of HSR in Yunnan has also led to significant improvements in the transportation of goods and people,

enhancing trade and mobility. This has resulted in increased economic activities, higher productivity, and greater regional integration, essential for sustained economic growth. Moreover, the tourism industry in Yunnan has seen rapid growth due to the improved accessibility of key tourist destinations, leading to higher tourist arrivals and revenue.

6.1.2. Affecting High-Speed Rail Under Differences Context

The case study of four cities in Yunnan demonstrates that the construction of high-speed rail significantly promotes local economic development. The high-speed rail enhances connectivity, reduces travel time, and facilitates the movement of goods and people, leading to increased economic activities, job creation, and higher GDP growth. However, the author recognizes that high-speed rail is only one factor among many affecting regional economic development. For instance, Yunnan's economic growth is also driven by its diversified economy, including agriculture, manufacturing, and tourism, which is supported by rich natural resources and significant investments in infrastructure.

Several critical differences must be considered when comparing the situation in Yunnan to Thailand. One significant difference is land ownership laws. In China, the government owns the land and can more easily acquire land for large infrastructure projects like high-speed rail. In contrast, Thailand has a complex land ownership system, with much land privately owned, which can significantly increase the cost and complexity of acquiring land for high-speed rail construction. Additionally, Thailand's political and administrative context may introduce potential delays and challenges that differ from those experienced in China. Therefore, while the Yunnan case provides valuable insights, the author should consider these contextual differences when analyzing the impact of high-speed rail on Thailand's regional economic growth.

6.1.3. Adapting Analysis to Reflect Thailand's National Conditions

To effectively analyze the impact of HSR on Thailand's regional economy, it is essential to understand Thailand's unique economic characteristics. A strong manufacturing sector, a significant agricultural base, and a thriving tourism industry characterize Thailand's economy.

Tourism is a critical sector for Thailand, which is known for its rich cultural heritage, beautiful landscapes, and vibrant cities. The sector is a major contributor to the economy, generating significant revenue and employment. HSR can make it easier and faster for tourists to reach popular destinations nationwide. This includes both well-known sites and emerging attractions in less-developed regions. Improved accessibility can lead to an increase in tourist arrivals and spending. By connecting major cities with regional attractions, HSR can promote the development of new tourism hubs. This

can help distribute tourist traffic more evenly across the country, reducing congestion in over-visited areas and bringing economic benefits to less frequented regions. Improved transportation can make Thailand more attractive for international conferences, exhibitions, and events. This tourism segment can bring high-spending visitors and enhance Thailand's reputation as a global meeting hub. HSR can also stimulate domestic tourism by making weekend getaways and short trips more feasible for Thai residents. This can increase overall tourist numbers and generate additional revenue for local businesses. Tourism growth can multiplier the economy, stimulating demand for services such as hospitality, retail, and entertainment. This can lead to job creation and increased economic activity in related sectors.

Moreover, Thailand's strategic location in Southeast Asia positions it as a crucial hub for regional trade and investment. HSR can facilitate the efficient movement of goods and people across borders, strengthening trade ties with countries like Laos, Cambodia, and Malaysia. This can enhance Thailand's position as a regional trade hub and boost economic integration within ASEAN. Enhanced connectivity can attract investment in logistics and infrastructure projects, such as ports, airports, and industrial parks. This can further support Thailand's trade activities and economic growth. The development of HSR can encourage the establishment of cross-border economic zones, where businesses from neighboring countries can collaborate and trade more efficiently. This can lead to increased economic cooperation and shared prosperity in the region.

HSR can play a crucial role in addressing regional economic disparities by promoting balanced development across Thailand; by connecting rural areas with urban centers, HSR can facilitate the flow of goods, services, and people, reducing the economic gap between these regions. This can lead to more equitable economic growth and improved living standards in rural areas. HSR can encourage the decentralization of economic activities, reduce congestion in major cities, and promote the development of secondary cities and towns. This can help distribute economic benefits more widely across the country. Improved transportation can enhance access to essential education, healthcare, and employment opportunities. This can improve the quality of life for residents in remote areas and contribute to overall social development.

The development of HSR can enhance Thailand's global competitiveness and integrate Thailand more effectively into global trade networks, making it a more attractive destination for international business and investment. Enhanced connectivity can improve the efficiency of trade routes and logistics chains. By supporting multiple sectors such as manufacturing,

agriculture, and tourism, HSR can contribute to the diversification of Thailand's economy. This can make the economy more resilient to external shocks and promote sustainable growth. The implementation of HSR requires advanced technology and innovation, which can spill over into other sectors of the economy. This can drive technological progress, enhance productivity, and foster a culture of innovation in Thailand.

By understanding and adapting to Thailand's unique economic characteristics, policymakers and stakeholders can develop strategies to maximize the benefits of HSR. This comprehensive approach ensures that the impact of HSR is aligned with Thailand's national development goals and contributes to long-term economic prosperity.

6.2. Prioritizing Factors and Expectations for Nong Khai Province

This research focuses on the development of Nong Khai Province in terms of border trade, mainly through the implementation and impact of the Sino-Thai high-speed railway. By examining the historical and current economic landscape of Nong Khai, alongside the transformative effects observed in Yunnan Province, China, this study aims to comprehensively analyze the potential benefits and challenges associated with enhanced connectivity and trade integration. The research employs the AHP to systematically evaluate and prioritize the critical factors influencing the success of border trade development in Nong Khai.

The analysis results are based on the input of 12 experts representing various relevant agencies from the public and private sectors. These experts include Nong Khai Customs House representatives, provincial commerce, import-export entrepreneurs along the Nong Khai Province border, and transport companies. The outcomes of the analysis consist of prioritizing factors that facilitate border trade development in Nong Khai Province. This prioritization is determined through pairwise comparisons between the main criterion and sub-criteria. The Expert Choice program aggregates expert judgments to conduct the data analysis.

6.2.1. Results of Weight Analysis and Prioritization of Main Criteria Factor

The weighting and prioritization of each factor were obtained from the evaluation of questionnaires completed by experts, and the influence weights will be calculated using the Geometric Mean to analyze the data. The results are shown in the following table.

Table 4. Summarizes the influence weights of the Main criteria factor.

| Expert | Weight values of the main factors. | | | | | C.R. |
|----------------|------------------------------------|-------|-------|-------|-------|-------|
| | E1 | E2 | E3 | E4 | E5 | |
| Expert 1 | 0.043 | 0.348 | 0.304 | 0.080 | 0.225 | 0.089 |
| Expert 2 | 0.034 | 0.086 | 0.395 | 0.145 | 0.340 | 0.057 |
| Expert 3 | 0.142 | 0.251 | 0.361 | 0.138 | 0.108 | 0.090 |
| Expert 4 | 0.081 | 0.188 | 0.106 | 0.256 | 0.329 | 0.085 |
| Expert 5 | 0.111 | 0.395 | 0.226 | 0.085 | 0.184 | 0.096 |
| Expert 6 | 0.192 | 0.303 | 0.090 | 0.130 | 0.285 | 0.087 |
| Expert 7 | 0.149 | 0.144 | 0.236 | 0.176 | 0.295 | 0.091 |
| Expert 8 | 0.169 | 0.303 | 0.176 | 0.188 | 0.164 | 0.091 |
| Expert 9 | 0.143 | 0.474 | 0.064 | 0.092 | 0.227 | 0.083 |
| Expert 10 | 0.098 | 0.114 | 0.468 | 0.071 | 0.249 | 0.052 |
| Expert 11 | 0.140 | 0.513 | 0.200 | 0.056 | 0.091 | 0.085 |
| Expert 12 | 0.047 | 0.483 | 0.271 | 0.082 | 0.117 | 0.065 |
| Geometric Mean | 0.112 | 0.296 | 0.236 | 0.129 | 0.227 | 0.080 |

From Table 4, it is possible to sort the most influential weights and prioritize the main factors promoting the development of border trade in Nong Khai Province and the Thai-Laos-China railway linkage under the Belt and Road Initiative. The following results were obtained from the interviews with twelve experts: First, factor 2, Infrastructure

connectivity, has a geometric mean of 0.296. Second, factor 3, the reduction of trade restrictions, has a geometric mean of 0.236. Third, factor 5, the connection between the people, has a geometric mean of 0.227. Fourth, factor 4, Financial support, has a geometric mean 0.129. Fifth, factor 1, policy for promoting regional cooperation, has a geometric mean of 0.112.

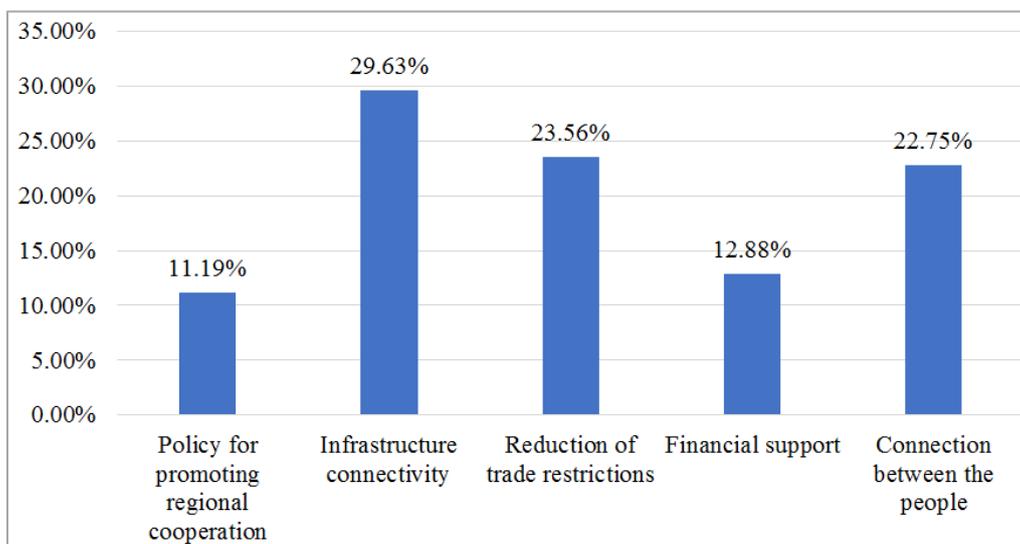


Figure 11. Weight of the main factors promoting the development of border trade.

By calculating the percentage values, the analysis reveals that infrastructure connectivity holds the highest level of

importance, accounting for 29.63% of the total. The second most crucial factor is the reduction of trade restrictions, with

a significance weight of 23.56%. The connection between the people is closely followed, contributing 22.75% towards the overall border trade development. Financial support represents a weight of 12.88%, indicating its moderate importance. Lastly, the policy for promoting regional cooperation holds the least weight at 11.19%. The consistency ratio (CR) is calculated to be 0.080, well below the threshold value of 0.10. This low value indicates high accuracy and consistency in the data analysis results, as illustrated in Figure 11.

6.2.2. Results of Weight Analysis and Prioritization of Sub-Criteria Factor

Firstly, the influence weights of sub-criteria factors used in decision-making for policy-promoting regional cooperation reveal three key factors. The weighted values obtained from expert evaluations are presented in Table 5 below.

Table 5. Weights of the sub-criteria factor in the policy for promoting regional cooperation.

| Expert | Weight values of the secondary factors | | | C.R. |
|----------------|--|-------|-------|-------|
| | S1.1 | S1.2 | S1.3 | |
| Expert 1 | 0.311 | 0.196 | 0.493 | 0.024 |
| Expert 2 | 0.226 | 0.101 | 0.674 | 0.062 |
| Expert 3 | 0.169 | 0.443 | 0.387 | 0.008 |
| Expert 4 | 0.238 | 0.136 | 0.625 | 0.008 |
| Expert 5 | 0.157 | 0.249 | 0.594 | 0.024 |
| Expert 6 | 0.120 | 0.272 | 0.608 | 0.033 |
| Expert 7 | 0.411 | 0.261 | 0.328 | 0.024 |
| Expert 8 | 0.211 | 0.548 | 0.241 | 0.008 |
| Expert 9 | 0.055 | 0.358 | 0.587 | 0.017 |
| Expert 10 | 0.236 | 0.062 | 0.701 | 0.032 |
| Expert 11 | 0.193 | 0.724 | 0.083 | 0.029 |
| Expert 12 | 0.077 | 0.186 | 0.737 | 0.029 |
| Geometric Mean | 0.205 | 0.278 | 0.517 | 0.021 |

From Table 5, the prioritization of secondary factors used in the policy for promoting regional cooperation can be ordered as follows: Firstly, the most influential weight is assigned to factor 1.3, SME support policy (Local Business), with a geometric mean of 0.517. Secondly, factor 1.2, promotion of international business matching, has a geometric mean of 0.278. Lastly, factor 1.1, the Thailand-Laos-China Cooperation Framework, is assigned a geometric mean of 0.205, placing it in the third order. The consistency ratio (CR)

is calculated as 0.021, which is below the threshold of 0.05. This indicates that the results of the data analysis are consistent and deemed acceptable, supporting the explanation of their importance.

Secondly, the results of the data analysis, which compare the influence weights of the Secondary factors used in infrastructure connectivity, consist of three factors. The weight values obtained from experts are shown in Table 6.

Table 6. Weights of the sub-criteria factor in the infrastructure connectivity.

| Expert | Weight values of the secondary factors | | | C.R. |
|----------------|--|-------|-------|-------|
| | S2.1 | S2.2 | S2.3 | |
| Expert 1 | 0.481 | 0.114 | 0.405 | 0.013 |
| Expert 2 | 0.627 | 0.094 | 0.28 | 0.039 |
| Expert 3 | 0.413 | 0.26 | 0.327 | 0.024 |
| Expert 4 | 0.625 | 0.238 | 0.136 | 0.008 |
| Expert 5 | 0.528 | 0.14 | 0.333 | 0.024 |
| Expert 6 | 0.490 | 0.312 | 0.198 | 0.024 |
| Expert 7 | 0.312 | 0.198 | 0.490 | 0.024 |
| Expert 8 | 0.164 | 0.539 | 0.297 | 0.004 |
| Expert 9 | 0.267 | 0.064 | 0.669 | 0.013 |
| Expert 10 | 0.498 | 0.087 | 0.415 | 0.016 |
| Expert 11 | 0.665 | 0.104 | 0.231 | 0.039 |
| Expert 12 | 0.643 | 0.074 | 0.283 | 0.029 |
| Geometric Mean | 0.489 | 0.166 | 0.345 | 0.018 |

From Table 6, the prioritization of secondary factors used in decision-making on infrastructure connectivity can be ordered as follows: Firstly, Factor 2.1, Linking the transportation system through the border by rail and land, had a geometric mean of 0.489, indicating its highest level of influence. Secondly, Factor 2.3, Improving public transport links within the area, had a geometric mean of 0.345. Lastly, Factor 2.2, Connecting digital infrastructure, had a geometric mean of 0.166, representing the lowest level of influence among the factors. The consistency ratio (CR) is calculated as 0.018, which is below the threshold of 0.05. This indicates that the results of the data analysis are consistent and deemed acceptable. It demonstrates the importance of considering these prioritized factors when making decisions related to infrastructure connectivity.

Thirdly, the results of the data analysis, which compare the influence weights of the Secondary factors used in the reduction of trade restrictions, consist of three factors. The weight

values obtained from experts are shown in Table 7.

Table 7. Weights of the sub-criteria factor in the reduction of trade restrictions.

| Expert | Weight values of the secondary factors | | | C.R. |
|----------------|--|-------|-------|-------|
| | S3.1 | S3.2 | S3.3 | |
| Expert 1 | 0.268 | 0.614 | 0.117 | 0.033 |
| Expert 2 | 0.327 | 0.260 | 0.413 | 0.024 |
| Expert 3 | 0.659 | 0.156 | 0.185 | 0.013 |
| Expert 4 | 0.196 | 0.493 | 0.311 | 0.024 |
| Expert 5 | 0.157 | 0.594 | 0.249 | 0.004 |
| Expert 6 | 0.164 | 0.539 | 0.297 | 0.004 |
| Expert 7 | 0.490 | 0.312 | 0.198 | 0.024 |
| Expert 8 | 0.350 | 0.478 | 0.172 | 0.061 |
| Expert 9 | 0.808 | 0.074 | 0.118 | 0.024 |
| Expert 10 | 0.206 | 0.723 | 0.070 | 0.043 |
| Expert 11 | 0.677 | 0.192 | 0.131 | 0.043 |
| Expert 12 | 0.587 | 0.324 | 0.089 | 0.004 |
| Geometric Mean | 0.408 | 0.391 | 0.201 | 0.018 |

From Table 7, the most influential weights and priorities of the secondary factors used in the Reduction of Trade restrictions can be ordered as follows: First, Factor 3.1: Fast and convenient customs clearance has a geometric mean of 0.408. Second, Factor 3.2: Implement measures to reduce tax rates has a geometric mean of 0.391. Third, Factor 3.3: Investment promotion measures have a geometric mean of 0.201. The Consistency ratio (CR) was 0.018, and the obtained value was not more than 0.05, indicating that the results of the data analysis were consistent with the reasons considered acceptable. These findings can be used to explain the importance of the factors.

Fourthly, the results of the data analysis, which compare the influence weights of the secondary factors used in the financial support, consist of three factors. The weight values obtained from experts are shown in Table 8.

Table 8. Weights of the sub-criteria factor in the financial support.

| Expert | Weight values of the secondary factors | | | C.R. |
|----------|--|-------|-------|-------|
| | S1 | S2 | S3 | |
| Expert 1 | 0.26 | 0.327 | 0.413 | 0.024 |

| Expert | Weight values of the secondary factors | | | C.R. |
|----------------|--|-------|-------|-------|
| | S1 | S2 | S3 | |
| Expert 2 | 0.249 | 0.157 | 0.594 | 0.024 |
| Expert 3 | 0.413 | 0.26 | 0.327 | 0.024 |
| Expert 4 | 0.268 | 0.117 | 0.614 | 0.033 |
| Expert 5 | 0.268 | 0.117 | 0.614 | 0.033 |
| Expert 6 | 0.198 | 0.312 | 0.490 | 0.024 |
| Expert 7 | 0.241 | 0.211 | 0.548 | 0.008 |
| Expert 8 | 0.481 | 0.204 | 0.315 | 0.098 |
| Expert 9 | 0.092 | 0.154 | 0.755 | 0.015 |
| Expert 10 | 0.211 | 0.241 | 0.548 | 0.008 |
| Expert 11 | 0.589 | 0.252 | 0.159 | 0.024 |
| Expert 12 | 0.093 | 0.221 | 0.685 | 0.024 |
| Geometric Mean | 0.267 | 0.222 | 0.511 | 0.023 |

From Table 8, the most influential weighting and prioritization of the alternative factors used in making financial support decisions can be ordered: First, Factor 4.3, an efficient and secure payment system, has a geometric mean of 0.511. Second, Factor 4.1, Financial support funds, has a geometric mean of 0.267. Third, Factor 4.2, Foreign currency exchange, has a geometric mean of 0.222. The consistency ratio (CR) is calculated to be 0.023, and this obtained value falls within the acceptable range of 0.05, indicating that the data analysis results are consistent with the acceptable reasons. These findings can be utilized to explain the significance and meaning of the factors' importance in the context of financial support.

Lastly, the results of the data analysis, which compare the influence weights of the secondary factors used in the connection between the people, consist of four factors. The weight values obtained from experts are shown in Table 9.

Table 9. Weights of the sub-criteria factor in the connection between people.

| Expert | Weight values of the secondary factors | | | | C.R. |
|----------|--|-------|-------|-------|-------|
| | S1 | S2 | S3 | S4 | |
| Expert 1 | 0.112 | 0.210 | 0.295 | 0.383 | 0.065 |
| Expert 2 | 0.431 | 0.246 | 0.189 | 0.135 | 0.064 |
| Expert 3 | 0.318 | 0.114 | 0.182 | 0.386 | 0.055 |
| Expert 4 | 0.49 | 0.231 | 0.163 | 0.116 | 0.036 |
| Expert 5 | 0.236 | 0.168 | 0.135 | 0.461 | 0.064 |

| Expert | Weight values of the secondary factors | | | | C.R. |
|----------------|--|-------|-------|-------|-------|
| | S1 | S2 | S3 | S4 | |
| Expert 6 | 0.081 | 0.389 | 0.180 | 0.350 | 0.019 |
| Expert 7 | 0.370 | 0.221 | 0.171 | 0.238 | 0.064 |
| Expert 8 | 0.277 | 0.138 | 0.367 | 0.218 | 0.046 |
| Expert 9 | 0.048 | 0.442 | 0.068 | 0.442 | 0.018 |
| Expert 10 | 0.083 | 0.127 | 0.287 | 0.503 | 0.066 |
| Expert 11 | 0.200 | 0.101 | 0.145 | 0.554 | 0.036 |
| Expert 12 | 0.095 | 0.064 | 0.316 | 0.526 | 0.068 |
| Geometric Mean | 0.206 | 0.204 | 0.219 | 0.371 | 0.046 |

From Table 9, the most influential weights and prioritization of the alternative factors used in decision-making on the connection between people can be ordered as follows: First, Factor 5.4, the fast passport issuance process, has a geometric mean of 0.371. Second, factor 5.3, enhancing cultural exchange, has a geometric mean of 0.219. Third, factor 5.1, raising labor standards in the area, has a geometric mean of 0.206. Fourth, factor 5.2, controlling transnational infectious diseases, had a geometric mean 0.204. The consistency ratio (CR) is 0.046, and its value does not exceed 0.05, indicating that the data analysis results were consistent with the acceptable reasons. These results can be used to explain the importance of the factors.

The research results have analyzed the priorities of all main and secondary factors. These results can be summarized as the influence weights of factors and decision-making guidelines. The analysis was based on a survey conducted among experts and senior executives in agencies from public and private sectors, such as Nong Khai Customs House, the provincial commerce department, the Provincial Chamber of Commerce, and transport companies. The results obtained from the Analytic Hierarchy Process (AHP) decision-making process reveal that the factors crucial for the development of border trade in Nong Khai Province and the Thai-Laos-China railway linkage under the Belt and Road Initiative are as follows:

1) Experts identified Infrastructure connectivity as the most significant factor (0.296) in selecting border trade development factors. According to the analysis conducted using the analytical hierarchy process (AHP), the importance of secondary factors related to various infrastructures was determined. It was discovered that linking the transportation system through the border by rail and land (0.489) held the highest value. Improving public transport links within the area (0.345) was deemed crucial in the second position. The third factor was connecting digital infrastructure (0.166), a notion widely agreed upon by many agencies. Specifically, the linkage of transport infrastructure via land rails, especially

concerning expediting the construction of the second Thai-Lao Friendship Bridge, was emphasized. This was deemed necessary due to the insufficient width of the existing railway tracks, which cannot accommodate the new Laos electric train intended to operate on the Thai side nor the high-speed trains currently under construction on the Thai side. The construction of the second Thai-Lao Friendship Bridge will address these bottlenecks and support the transportation of passengers and goods between Thailand, Laos, and China. Such improvements are crucial for promoting future tourism and international trade.

2) Reduction of trade restrictions was identified as the second main factor (0.236) considered by experts in selecting border trade development factors. The significance of the reduction of trade restrictions secondary factor was also assessed. The analysis conducted using the Hierarchical Analysis (AHP) method determined that fast and convenient customs clearance (0.408) held the highest value as the first priority. As for the second priority, implementing measures to reduce tax rates (0.391) was deemed essential. Lastly, investment promotion measures (0.201) were considered the third priority.

3) Connection between people was identified as the third main factor (0.227) that experts considered in selecting factors for border trade development. The significance of the connection between people and secondary factors was assessed through the analytical hierarchy process (AHP). It was determined that the fast passport issuance process (0.371) was the highest priority. Enhancing cultural exchange (0.219) was ranked as the second priority. Raising labor standards in the area (0.206) was the third priority, followed by controlling transnational infectious diseases (0.204) as the fourth priority.

4) Experts considered financial support the fourth main factor (0.129) in selecting border trade development factors. The importance of financial support secondary factors was assessed through the analysis conducted using the Hierarchical Analysis (AHP) method. It was determined that an efficient and secure payment system (0.511) was the highest priority. Financial support funds (0.267) were ranked second, followed by foreign currency exchange (0.222) in third place.

5) Policy for promoting regional cooperation was identified as the fifth main factor (0.112) that experts considered in selecting factors for developing border trade. The significance of the policy secondary factors for promoting regional cooperation was assessed through the analysis conducted using the hierarchical analysis (AHP) method. It was found that the SME Support Policy (Local Business) (0.517) had the highest value, ranking first. Promoting international business matching (0.278) was considered crucial in the second position. Lastly, the Thailand-Laos-China Cooperation Framework (0.205) was ranked third.

7. Conclusions

The research results have highlighted the key factors in-

fluencing border trade development in Nong Khai Province through the Sino-Thai high-speed railway. The Analytic Hierarchy Process (AHP) has identified infrastructural connectivity, reduction of trade restrictions, connection between people, financial support, and policy for promoting regional cooperation as critical components. The insights gained from the survey conducted among experts and senior executives underscore the importance of prioritizing these factors to maximize the benefits of the high-speed rail project and enhance regional economic integration.

To fully leverage the opportunities presented by the Sino-Thai high-speed railway, several strategic actions are recommended for Nong Khai Province. First, enhancing infrastructural connectivity is crucial. Prioritizing the construction of the second Thai-Lao Friendship Bridge will address current bottlenecks and facilitate smoother transportation of passengers and goods. Additionally, improving public transport links within Nong Khai and developing robust digital infrastructure will support greater mobility and accessibility, complementing physical infrastructure improvements; Second, reducing trade restrictions is essential for fostering a more conducive trade environment. Streamlining customs clearance processes to ensure fast and efficient procedures will reduce delays and improve trade flow. Implementing measures to reduce tax rates and promoting investment through targeted incentives will further encourage trade activities and business growth; Third, strengthening human connectivity will play a significant role in enhancing cross-border interactions. Facilitating a fast passport issuance process and promoting cultural exchange programs will build stronger interpersonal and business relationships. Raising labor standards and implementing measures to control transnational infectious diseases will improve workforce quality and public health safety; Fourth, providing robust financial support is vital for sustaining and expanding trade activities. Developing an efficient and secure payment system, creating financial support funds, and facilitating easy access to foreign currency exchange services will ensure reliable financial mechanisms for trade transactions; Finally, promoting policies for regional cooperation will enhance the strategic goals of the Belt and Road Initiative. Supporting SMEs through targeted policies, encouraging international business matching, and strengthening the Thailand-Laos-China cooperation framework will foster trilateral cooperation and boost regional economic integration.

By implementing these recommendations, Nong Khai province can effectively maximize the economic benefits of the high-speed rail project, fostering sustainable growth and enhancing its role as a critical player in regional trade.

Abbreviations

| | |
|-----|----------------------------|
| HSR | High-Speed Rail |
| BRI | Belt and Road Initiative |
| AHP | Analytic Hierarchy Process |

| | |
|-----|------------------------|
| GDP | Gross Domestic Product |
| ADB | Asian Development Bank |
| CR | The Consistency Ratio |

Author Contributions

Pongsathorn Kamnoi is the sole author. The author read and approved the final manuscript.

Conflicts of Interest

The author declares no conflicts of interest.

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