China vs India in the Himalayas: Comparing economic development in Tibet and Ladakh☆

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ARTICLE INFO	ABSTRACT
	The Himalayas are of great strategic importance for China and India but the remote region remains relatively underdeveloped. This paper conducts a comparative analysis of China's Tibet and India's Ladakh with the aim of identifying common and idiosyncratic factors relevant for local economic development. A descriptive analysis explores the administrative, military, demographic, and economic factors in each region. Moreover, we use an ARDL model to examine the long-run relationship between fiscal transfers and regional growth. Lastly, three measures are employed to investigate the extent of integration between the Himalayan regions and the rest of their respective countries. The results indicate that Tibet and Ladakh exhibit many similarities related to a limited degree of regional autonomy, a strong military presence, and the importance of agriculture and services. The empirical investigation confirms the cointegration between transfers and growth. Regional integration is furthered by increasing inflows of domestic tourists and expanding freight traffic.

1. Introduction

The Himalayas with their harsh climate, inhospitable terrain, high altitude, infertile soil, and sparse population have little potential for rapid economic growth. In the age of globalization, when emerging economies take advantage of worldwide production networks and value chains to trade and attract foreign investment, the landlocked Himalayas remain relatively underdeveloped and isolated from the rest of the world. It is not coincidental that countries in the region, such as Nepal and Bhutan, rank among the poorest in the world by income level.

At the same time, the strategic location of the Himalayas at the crossroads of Central Asia has attracted the attention and intervention of adjoining empires and states for centuries. Although they enjoyed independence or autonomy at some point in their history, by the 1950s several Himalayan regions ended up as part of the newly emerged China and India. This process created both risks and opportunities for economic development. On the one hand, being part of a larger common market can be beneficial in fostering trade and investment, which, in turn, boosts employment and economic growth. On the other hand, peripheral regions with little growth potential could be neglected not only by market forces but also by a central government not particularly intent on reducing regional disparities.

This paper explores economic development and regional integration of Tibet and Ladakh in a comparative context. The two Himalayan regions have shared close religious, cultural, and economic ties for centuries but by 1950 a new border emerged between them, severing all links ever since. Ladakh became part of India, while Tibet turned into an autonomous region of China. While China and India were initially underdeveloped, market reforms implemented since the 1980s have generated rapid economic growth and prosperity in both countries. However, not all regions have benefited equally from the economic progress, and Tibet and Ladakh remain near the bottom of income rankings in their respective nations.

The main objectives of this paper are threefold. First, we conduct a descriptive analysis aimed at revealing similarities and differences between Tibet and Ladakh across various aspects related to economic development. In particular, we study the administrative status, the role of the military, the regional economy, and demography. Second, we explore the relationship between economic growth and fiscal transfers from the central government for the two regions in a comparative perspective. In particular, we estimate an ARDL model for Tibet, producing coefficients for the short-run dynamics and the long-run equilibrium relationship between Tibet's GDP growth and several explanatory variables, including transfers and national GDP trends.

Third, we employ three indicators to assess the extent of economic integration of Tibet and Ladakh within China and India, respectively.

The literature on the economic development of the Himalayan regions of China and India tends to focus on specific issues, often related to agriculture. For instance, Dolker (2018) analyzes the transition of Ladakhi agriculture from traditional crops and practices towards new cash crops and mechanization, while the study by Angmo et al. (2017) reports on the effectiveness of using greenhouses to grow three cycles of leafy vegetables instead of a single cycle in the open. Bahuguna and Ramaswamy (2022) describe how Ladakhi nomadic pastoralists who produce the famous pashmina wool are increasingly abandoning goat herding to migrate into the bigger cities where they work in the construction or tourism industries. Brown et al. (2021) investigate the effect of market integration between Tibet and the rest of China, arguing that the increasing number of sheep in Tibet will benefit local farmers only if they can sell the meat to the rest of China.

Comparative studies in this context are relatively few and typically focus on non-economic issues. For instance, McGranahan (2003) adopts a political and anthropological perspective to examine similarities between the conflicts in Kashmir and Tibet. Taking on a polemic attitude, Jehangir (2023) compares Indian and Pakistani Kashmir across various economic and social indicators to conclude that the former is better off. A number of works have compared Tibet and Xinjiang in terms of the policies implemented by the Chinese central government towards autonomous regions (Chung, 2018; Mukherjee, 2015). The lack of comparative studies on the economic development of the Indian and Chinese parts of the Himalayas provides a key motivation for the current paper.

The broader goal of the paper is to investigate how large emerging countries treat peripheral regions that have limited economic potential but are important for national security. Tibet and Ladakh are particularly suited as a case study because they exhibit many common features but ended up as a part of countries with very different political and economic systems. Comparative analysis can thus reveal how these Himalayan regions have fared in different environments and how beneficial their integration has been in terms of promoting growth and improving living standards. In this context, it is important to note that market reforms were implemented in China starting in the late 1970s, while the economic liberalization of India began more than a decade later. This adds another dimension to the analysis where India is lagging behind China in terms of economic development and prosperity, and this is likely reflected in the comparisons between Tibet and Ladakh.

An important aspect of the paper is the investigation of the role of fiscal transfers on the economic development of peripheral regions. A version of fiscal federalism exists in both China (Qian and Weingast, 1996) and India (Kelkar, 2019) despite the differences in their political institutions and it is useful to adopt a political economy framework which would help us conceptualize the major issues of the central-local relations. In a system of fiscal federalism, revenue and expenditure responsibilities are allocated to different levels of the government (Oates, 1972). In both China and India, the central government is collecting the majority of taxes, while regional and local governments have limited tax powers but higher expenditure responsibilities. Accordingly, fiscal transfers from the central government are necessary to achieve fiscal equalization across regions, thus benefitting poorer regions. In addition, the central government has its own strategic projects of national importance that are financed directly. This can also be an advantage for peripheral regions, if they are important for the national security by being located along sensitive borders. Last but not least, the central government might consider offering extra funding for political reasons, giving priority to regions ruled by the same political party as the center or exhibiting discontent among local ethnic majorities.

The rest of the paper is structured as follows. In the next section, we conduct the descriptive analysis of administrative, military, economic, and demographic factors. In Section 3, we conduct the empirical investigation of growth and fiscal transfers, while in Section 4 we focus on the extent of regional integration. Section 5 provides a summary discussion and some conclusions.

2. Comparative aspects

We begin with a descriptive comparative analysis of the common features and particularities of Tibet and Ladakh.

2.1. Land area and boundaries

Tibet (see map in Fig. 1) as an autonomous region of China spreads across a territory of more than 1.2 million km^2. Most of the central and northern part of the region is occupied by the Tibetan Plateau, an arid and flat area with an average elevation of 5000 m, which is surrounded by high mountain ranges (including the Himalayas in the south) and dotted by lakes but has no major river systems. By contrast, South and Southeast Tibet is crisscrossed by rivers that form fertile mountain valleys where most of the agricultural activity is concentrated (Richardson et al., 2023). To the north and west, the region borders four Chinese provinces, while to the south it is contiguous to India, Nepal, and Bhutan, while in the east it shares a border with Ladakh

Ladakh (see map in Fig. 2) in its current boundaries as a union territory of India is dwarfed by Tibet's size, covering an area of approximately 60,000 km^2. Nested in the Himalayas, the region is a high-altitude desert with an elevation ranging from 2500 to over 7000 m. Most inhabited areas are concentrated in the valleys of the three main rivers that cross Ladakh, of which the Indus is the largest. Ladakh is divided into a predominantly Buddhist district of Leh, which claims three quarters of the territory and slightly less than half the population, and a predominantly Muslim district of Kargil, which was created in 1979 (UT Administration of Ladakh, 2020). To the south and southwest, Ladakh borders the Indian states of Jammu & Kashmir and Himachal Pradesh, while in the northwest it adjoins Pakistan-administered Kashmir. In the east and southeast, Ladakh shares a border with Chinese Tibet, where violent skirmishes between Indian and Chinese forces occur on a regular basis.

2.2. Administrative status

Tibet was incorporated into China in 1950–51, a year after the founding of the People's Republic, and was initially allowed to retain its traditional political and economic system. A revolt against Chinese rule in 1959 marked the end of relative autonomy and the beginning of a rapid integration into the Chinese state. As part of this process, the Tibet Autonomous Region (TAR) was formed in 1965 and is the subject of this investigation. The Chinese constitution and the more detailed Regional Ethnic Autonomy Law provide for self-governance of ethnic minorities in autonomous regions, granting them a broad range of powers in administrative, legislative, economic, financial, and cultural matters, among others. The law stipulates that ethnic minorities should be proportionally represented in the regional parliament (People's Congress) and should occupy all top administrative positions, such as head of the regional government and chairperson of the Standing Committee of the People's Congress. Moreover, the regional People's Congress has the right to enact regulations suited to the specific conditions of the region and to request that national policies be implemented in a way that conforms with local conditions or not be implemented at all. Autonomous regions enjoy preferential treatment regarding transfer payments from the central government and are entitled to compensation when natural resources are extracted from the area (United States Congressional, 2006).

In practice, many of these autonomous powers are difficult or impossible to implement because the autonomy law is vague and there are no legal mechanisms to enforce it. The right of the regional parliament to enact self-governing regulations is limited by the fact that such legislative proposals have to be submitted to the National People's

Fig. 1. Map of Tibet.

Fig. 2. Map of Ladakh.

Congress for approval and often face resistance and rejection. Most promulgated regulations are redundant or superficial and deal with educational and cultural issues (Zhang, 2012). With regard to personnel matters, although the head of the regional government has been an ethnic Tibetan since 1979, the more powerful position of the secretary of the regional committee of the Chinese Communist Party (CCP) has always been held by a Han Chinese. This hierarchy is further manifested by the fact that the head of the regional government also serves as the deputy party secretary.

Unlike the unitary state in China, India is a federation of states that acceded to the Union at the time of independence in 1947, eventually surrendering their autonomy and accepting the constitution. Ladakh was part of the princely state of Jammu and Kashmir (J&K), which as a majority-Muslim region joined the Union very hesitantly. After intense negotiations with the federal government, J&K managed to obtain a unique status, giving the state wide-ranging autonomy unlike any other region in the country. As stipulated in Article 370 of the Indian constitution, J&K had the right to its own constitution, flag, prime minister, and even judiciary. The legislative power of the Indian parliament extended only to the areas of defense, communications, and external affairs. Other national laws did not apply to J&K without the explicit approval of the state government (Sofi, 2021). Moreover, only permanent residents were allowed to own property, obtain government jobs, and receive education and health care in the state. This imposed implicit restrictions on migration from other parts of India.

Despite the high degree of autonomy of the state as a whole, Ladakh felt marginalized, having only one representative in the lower house of the Indian parliament (out of more than 500) and only three (out of 120) in the J&K state parliament. Especially the Buddhist-majority district of Leh demanded for years a more equitable share of economic resources and self-governance as recognition for its cultural identity in a Muslim-dominated region. In 1995, Ladakh was granted the right to establish in each of its two districts an Autonomous Hill Development Council, a locally elected body that is in charge of economic development plans, local industries, use of land and natural resources, and education, among others. In practice, the autonomy was limited by the fact that any development plans had to receive approval from the state government, which was often refused. Furthermore, the Council members were state employees, making them more susceptible to pressure from the state bureaucracy (Kothari et al., 2019).

In 2019, the Indian government unexpectedly revoked Article 370, ending the special status of J&K. In the process, Ladakh was separated and given the status of a union territory, which, in contrast to a state, is ruled directly by the federal government. This step certainly elevates the stature of Ladakh, recognizing its unique cultural identity and promising employment opportunities and more generous financial support from the center. However, Ladakh was not granted its own elected legislature and is administered by a lieutenant governor, appointed by the President of India. The first two lieutenant governors have not been ethnic Ladakhis and have no previous associations with the region. In addition, the lifting of employment and property rights protections for local residents has opened up the region for migrants from other parts of India looking for employment and investment opportunities.

2.3. Military aspects

Tibet and Ladakh are located in border areas of great importance for the national security of their respective countries. Ladakh is contiguous to both China and Pakistan, the two main geopolitical rivals of India, and has witnessed several major military conflicts throughout its recent history. India and China were involved in a war in 1962, triggered by a border dispute over the Aksai Chin region that is controlled by China but claimed by India as part of Ladakh. Skirmishes have occurred in this area ever since, culminating more recently in deadly clashes between Indian and Chinese troops in 2020-21. Similarly, major battles of the Indo-Pakistan War in 1971 and the Kargil War in 1999 were fought along

the border between Ladakh and Pakistan. As a result, Tibet and Ladakh have witnessed large deployments of troops, especially alongside their border, since the 1950s. According to O'Donnell and Bollfrass (2020), the ground forces of the Tibet Military District number around 40,000 troops, while the forces of the Northern Command of the Indian Army headquartered in Ladakh total around 34,000, which represents 12 % of the local population. However, it is likely that the actual numbers in both regions are higher, if border police, paramilitary units, and supporting staff are counted.

Although there is no data on the number of ethnic Ladakhis serving in the Indian army, they have been involved in protecting Ladakh's borders alongside the regular military since 1947. The best-known unit is the Ladakhi Scouts, a 4000-strong Ladakh-based infantry regiment formed after the Sino-Indian War of 1962, which recruits mostly Ladakhis and Tibetans and specializes in mountain warfare. The People's Liberation Army (PLA) in China has also been trying to mobilize ethnic Tibetans to join the military and paramilitary forces, with the latest census reporting 7487 Tibetans on active duty in 2020, making up 0.37 % of total PLA forces. The most prominent Ladakhi officer in the Indian army, Chewang Rinchen, reached the rank of a colonel, while the PLA boasts at least five Tibetan major generals, all of whom serve in the Tibet Military District in positions as high as the district's deputy commander (Arpi, 2020).

The armed forces are omnipresent in both regions and play an important role in local economic development. In fact, most of the infrastructure in Tibet and Ladakh has been financed and built by the central government and the military with the main goal of strengthening the defense of the border regions by creating transportation links with the rest of the country. China began with the construction of motor roads to Tibet in the early 1950s to ensure the transportation of troops and supplies, which until then was possible only for a few months in the summer using yaks as pack animals. Three main arteries were built in subsequent years, connecting Tibet with the Chinese provinces of Sichuan and Qinghai in the west and the Xinjiang Autonomous Region in the north.[1] India also began in the 1950s with the construction of roads to Ladakh, which, similarly to Tibet, was difficult to reach and was completely sealed off from the rest of India during the winter months. The Border Roads Organization (BRO), a quasi-military unit, built two major highways, linking the two main cities of Ladakh, Leh and Kargil, to the states of J&K in the west and Himachal Pradesh in the south (Das, 2021). While the Sichuan-Tibet and Qinghai-Tibet roads remain open for most of the year, the ones linking Ladakh to India still close for several months during the winter. Tibet is also linked to the rest of China via a railway through the province of Qinghai.

2.4. Demographic factors

The high altitude, remoteness, and inhospitable environment of Tibet and Ladakh have a major impact on their demography. As the statistics in Table 1 indicate, both regions have an extremely low population density. Tibet is the size of Peru or South Africa but has a population of only 3 million, while Ladakh is larger than Croatia or Costa Rica but has slightly more than a quarter of a million inhabitants. The population of Tibet has roughly doubled between 1982 and 2020 censuses, while Ladakh's population has almost tripled since 1971. Another common feature is the large and growing share of adult males relative to females in both regions. The share of males in Ladakh was almost 60 % in 2011. Neither of the two regions was subject to family planning policies, which have caused a highly unbalanced sex ratio in favor of males among Han Chinese in recent decades. The most likely explanation is the growing influx of migrants (who tend to be male), as well as the large number of military personnel stationed in the border areas.

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[1] The road between Tibet and Xinjiang crossed disputed territory and was one of the main triggers of the Sino-Indian War in 1962.

Table 1

Demographic statistics of Tibet and Ladakh.

	Tibet (TAR)			Ladakh			Leh district (Ladakh)		
	1982	2000	2020	1971	2001	2011	1971	2001	2011
Population (thousands)	1890	2616	3648	105.3	236.5	274.3	68.4	117.2	133.5
Males (%)	49.2	50.7	52.5	50.6	54.7	57.2	49.9	54.9	59.2
Females (%)	51.8	49.3	47.5	49.4	45.3	42.8	50.1	45.1	40.8
Urban (%)	9.5	12.8	35.8	7.5	16.6	22.6	10.6	24.4	34.2
Rural (%)	90.5	87.2	64.2	92.5	83.4	77.4	89.4	75.6	65.8
Pop. Density (per sq. km)	1.6	2.2	3.1	2.3	4.0	4.6	1.2	2.6	3.0
Buddhist (%)				51.8	47.4	40.0	85.9	77.3	66.4
Muslim (%)				46.7	45.9	45.6	12.2	13.8	14.1
Hindu (%)				1.1	6.2	12.2	1.4	8.2	17.3
Ethnic Tibetan (%)	94.7	92.8	86.0						
Han Chinese (%)	4.9	6.1	12.2						

Note: Calculations based on the official census data for China and India. The most recent census for India is from 2011, as the 2021 census was postponed due to the pandemic. Data for Leh district is reported separately because this is the majority-Buddhist part of Ladakh that is culturally closest to Tibet.

Despite a relatively rapid increase in urbanization, the population remains predominantly rural with an urban share of around 35 % in Tibet and 23 % in Ladakh in the 2000s.

The ethnic/religious composition exhibits major changes in both regions. The Buddhist population in Ladakh (and in its majority-Buddhist district of Leh) has declined by more than 20 %, mostly because of a rapid increase in the Hindu minority, even in the presence of restrictions on migration from other parts of India until 2019. Furthermore, it should be mentioned that Ladakh hosts a large number of Tibetan refugees and their descendants, numbering around 7300 in Leh district as of 2012 (Jolden, 2015). In Tibet, the percentage of ethnic Tibetans also witnessed a drop (from 95 % to 86 %), while the share of Han Chinese has more than doubled over the last 40 years. While the barriers to migration in Ladakh were lifted only with the abrogation of Article 370 in 2019, Han Chinese migration to TAR has been actively promoted by the Chinese government since the 1960s. The influx of Chinese farmers to rural areas in Tibet has been very limited due to the harsh climate and the shortage of arable land, however government employees have been attracted by career opportunities, housing subsidies, and other benefits (Ma, 1995). State-sponsored infrastructure projects in Tibet have also brought in construction workers from other regions, while the economic boom of the past 30 years resulted in a market-driven migration of Han Chinese professionals, entrepreneurs, and service-industry workers to Tibetan cities (Zhu and Blachford, 2012). A similar tendency can be observed in Ladakh, where the flourishing tourism sector has offered new opportunities to business people and workers from other parts of India.

2.5. Economy

The remoteness, high altitude, and relative isolation have shaped the economies of Tibet and Ladakh. Traditionally, agriculture has been the mainstay of the local population, which, as we have seen in Table 1, remains predominantly rural. The nominal GDP of Tibet in 2022 was approximately 32 billion current US$, which is the size of the economy of Cyprus or Cambodia. As shown in Table 2, Tibet's GDP increased eightfold in real terms since the turn of the century, which translates into an average annual growth of 12 %. Despite this impressive achievement, Tibet remains the smallest regional economy in China. The economy has witnessed a fundamental structural change with agriculture's share dropping from more than 50 % in 1990 to less than 10 % in recent years. Industry's share has tripled over the same period, leading the secondary sector to account for a third of aggregate output. Although services experienced the smallest change, it was sufficient to transform them into the largest sector of the economy with more than half of GDP. The real GDP per capita grew relatively slowly in the 1990s but it increased sevenfold over the past two decades. Nevertheless, Tibet remains one of the poorest provinces in China.

Table 2

Economic statistics of Tibet and Ladakh.

	Tibet (TAR)			Ladakh
	1990	2000	2019	2019–20
Real GDP (bn $)	1.7	2.9	24.6	0.242[a]
- Agriculture (%)	50.9	30.1	8.1	
- Industry (%)	12.9	22.9	37.4	
- Services (%)	36.2	46.9	54.4	
Real GDP/capita ($)	671	999	6808	894[a]
Cashmere output/goat (kg)	0.088	0.085	0.151	0.262
Sheep wool/sheep (kg)	0.744	0.739	1.108	1.031
Tourist arrivals (mn)		0.61	40.1	0.280
Fiscal transfers/capita ($)	119.3	297.8	7874	2941[b]

Note: The real GDP variables for Tibet are expressed in 2019 constant yuan and for Ladakh in 2004–05 constant rupees. The conversion into USD used the official market exchange rate.
Source: Tibet: CEIC database. Ladakh: UT Administration of Ladakh (2020).
[a] The GDP numbers for Ladakh are for 2009–10 and were obtained from J&K Directorate of Economics and Statistics (2012).
[b] for 2020–21.

Data on Ladakh's GDP are not readily available and are not published on a regular basis, even after the region obtained the status of a union territory in 2019. The J&K Directorate of Economics and Statistics (2012) reports for fiscal year 2009–10 a GDP of $325 million in nominal and $242 million in real terms, which would make Ladakh one of the smallest economies in the world at par with Tonga or Micronesia. It is also dwarfed by Tibet's economy with a real GDP of $8.9 billion in 2009. Ladakh's per-capita GDP in 2009–10 was $1200 in nominal and $894 in real terms, making it wealthier than other districts within J&K and placing it below (but still close to) the Indian average.[2] However, Tibet was three times wealthier than Ladakh with $3021 (in real terms) in 2009.[3] Furthermore, within Ladakh, the real per-capita GDP of Leh district ($961) was higher than that for Kargil district ($833).

The sectoral composition has to be deduced from various statistics but Ladakh's economy seems to be dominated by agriculture and services. The secondary sector is represented by small-scale industries involved in handicrafts, weaving, and some mining. In 2019–20, only 5 small-scale enterprises were registered with the Directorate of Industries and Commerce in the Leh district of Ladakh. By contrast, the service

[2] The Gross District Domestic Product (GDDP) in India is defined as the sum of the value of all goods and services produced within the geographical boundary of the district after deducting the necessary inputs consumed in the process of production and financial intermediation services.
[3] In China, the GDP of a province or autonomous region is calculated similarly to the GDDP in India, focusing on the value added of that particular region.

sector in that district consists of more than 13,000 shops, hotels, guesthouses, and restaurants, employing almost 15,000 people (UT Administration of Ladakh, 2020). Most of these establishments cater to tourists, whose numbers have surged since the late 2000s (see left panel of Fig. 6) to reach 280,000 in 2019–20, exceeding probably the entire local population of Ladakh. For the same year, Chinese authorities report 40 million tourist arrivals in Tibet, which is an incredibly high number, concurring with the large share of the tertiary sector in the region's GDP.

With regard to agriculture, Ladakh had almost 200 cooperatives with a membership of 33,000 in 2019–20. Farmers mostly grow barley, wheat, vegetables, and fodder, while animal husbandry is dominated by sheep and goats (numbering close to 300,000 heads) that produce wool and pashmina. Table 2 provides a comparison with Tibet, where sheep and cashmere goats are also raised. In terms of productivity, Ladakh appears to be far ahead of Tibet regarding cashmere/pashmina output per goat but for wool both regions report similar yields per sheep.

3. Empirical analysis

Fiscal transfers are a key feature of the center-periphery relationship and could play an important role in the economic development of Tibet and Ladakh given their relatively low income levels. This section explores the effect of fiscal transfers on economic growth in an empirical framework. Unfortunately, only the data series for Tibet are sufficiently long to allow for an empirical investigation but we also gain some insights from the limited statistics available for Ladakh.

Since Ladakh became a union territory in 2019, it started receiving fiscal transfers directly from the central government, which has granted the same amount for the past four years. Ladakh obtains annually 59.6 billion rupees, which ranges between $730 and $800 million due to the variation in the exchange rate. Table 2 reports the per-capita amount for 2020–21 but the population data for Ladakh comes from the 2011 census and the 2021 census has been postponed due to the pandemic. Since the population has probably increased over the past 10 years, the fiscal transfers per capita since 2020 are more likely in the range of $2400-$2500 per annum. These amounts are less than a third of the transfers for Tibet. As shown in Table 2, funding for Tibet increased slowly in the 1990s and skyrocketed only since the late 2000s.

To study the role of fiscal transfers in Tibet, we employ an autoregressive distributed lag (ARDL) model (Pesaran and Shin, 1999; Pesaran et al., 2001), which can estimate the long-run relationship as well as the short-run dynamics of transfers and economic growth. Data availability is limited to annual frequency over the period 1985–2021, which compels us to focus only on a few relevant variables: Tibet's GDP, fixed investment, and fiscal transfers, as well as China's GDP. All four variables are obtained from the CEIC database, converted to real values (with 2019 as base year) using China's CPI, and expressed in natural logs to ensure that the estimated coefficients are interpreted as percentage change. Fixed investment is a key determinant of economic growth, while fiscal transfers is our variable of interest. The relationship between Tibet's and China's GDP is relevant because cointegration between these two series would indicate a deeper integration between Tibet and the rest of China.

The specification of the ARDL model is given by:

$$\Delta \ln Y_t = \alpha_0 + \sum_{i=1}^{k} \beta_i \Delta \ln Y_{t-i} + \sum_{j=0}^{m} \gamma_j' \Delta \ln X_{t-j} + \delta \ln Y_{t-1} + \theta' \ln X_{t-1} + \varepsilon_t$$

where Y_t is Tibet's GDP in year t and X_t is the vector of the explanatory variables (fixed investment, fiscal transfers, and China's GDP) in year t. The long-run relationship is described by the vector of coefficients θ for the variables in levels, while the short-run dynamics are assessed via the vector γ_j for the variables in differences. One of the advantages of the ARDL model is that the variables are not required to be integrated of the same order but they have to be either $I(0)$ or $I(1)$. The results of the

augmented Dickey-Fuller test (not reported) reveal that China's and Tibet's GDP as well as transfers and fixed investment contain a unit root but are integrated of order 1.

The results of the estimation are presented in Table 3. The optimal number of lags is determined with the help of the Akaike and the Schwarz/Bayesian Information Criteria, which generate the same recommendation. Fiscal transfers are assigned zero lags and are thus excluded from the short run dynamics. The long-run coefficients for fixed investment and fiscal transfers are positive and significant, while the one for China's GDP is positive but not significant. In the long run, a 1 % increase in fixed investment leads to a 0.29 % increase in Tibet's GDP. Fiscal transfers from the central government have a higher impact, raising Tibet's GDP by 0.35 %, highlighting the importance of financial support from the rest of China for the peripheral region. At the same time, the finding that Tibet's and China's GDP are not cointegrated should be interpreted with a certain caution. On the one hand, it could mean that Tibet is still not sufficiently well integrated with the rest of the country. On the other hand, there is a high correlation between China's GDP and the other two variables (transfers and fixed investment) which might be causing the lack of statistical significance.[4] The error correction (EC) term has the expected negative sign, implying a relatively speedy return to the long-run equilibrium (a correction of 46 % after the first year) following a short-run shock. As for the short-run dynamics in Table 3, fixed investment exhibits a negative sign but its contemporaneous effect is not statistically significant, while China's GDP appears to have a positive and significant effect on Tibet's GDP but the effect of the previous year is negative.

Next, we have to perform two tests, which are crucial in the context of the ARDL model. The first one is the bounds test (Pesaran et al., 2001) with the null hypothesis that there is no long-run relationship between the explanatory variables and economic growth. The F-test that all coefficients θ in Eq. (1) are zero generates a statistic of 5.23, which is below the critical value of 5.39 for the 5 % significance but the corresponding p-value of 0.056 is very close. Accordingly, we reject the null at 10 % and confirm the long-run equilibrium relationship between the variables in our model. The second test is the cumulative sum of recursive residuals (CUSUM), which helps us assess the stability of the coefficients in

Table 3
Results of the ARDL estimation.

	Short-run coefficients			Long-run coefficients
	Lag(0)	Lag(1)	Lag(2)	
$\Delta \ln$(Tibet GDP)		0.562***	0.558***	
		(0.181)	(0.157)	
$\Delta \ln$(Fixed Inv)	−0.134	−0.267**	−0.149**	
	(0.108)	(0.094)	(0.066)	
$\Delta \ln$(China GDP)	0.758***	−1.267***		
	(0.222)	(0.227)		
$\ln$(Fixed Inv)				0.286*
				(0.159)
$\ln$(Transfers)				0.345***
				(0.096)
$\ln$(China GDP)				0.156
				(0.198)
Constant				0.698
				(1.111)
EC				−0.458***
				(0.149)

Note: Number of obs.: 29; adj. R^2=0.80. *** $p<0.01$. ** $p<0.05$. * $p<0.1$.

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[4] If the ARDL model in Table 3 is estimated with China's GDP as the sole independent variable, then its short- and long-run effects on Tibet's GDP are positive and statistically significant. These results are available from the author upon request.
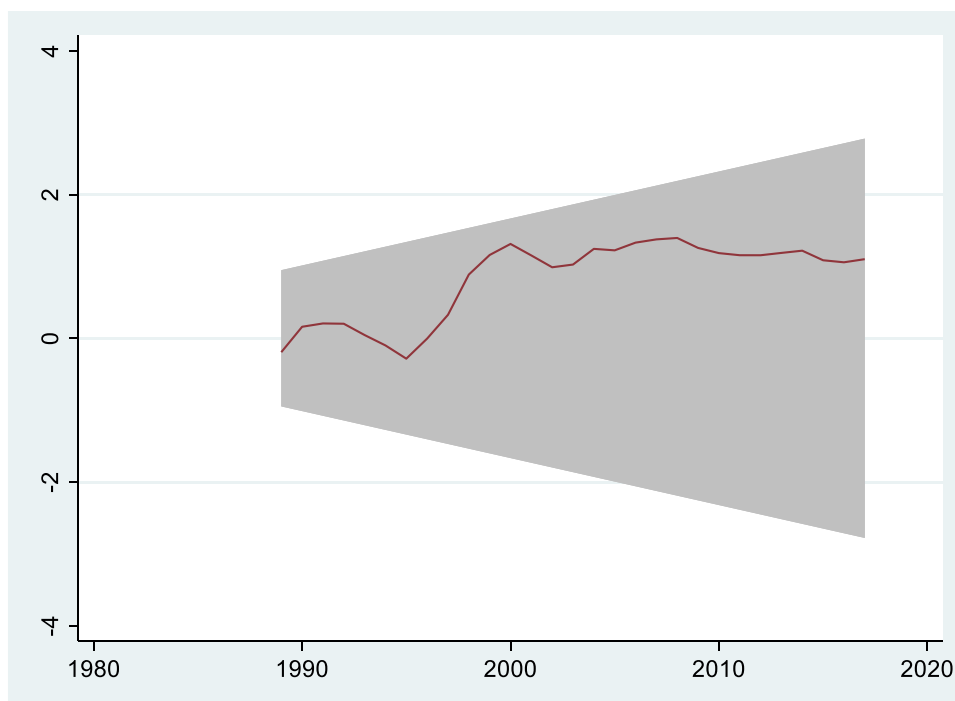
Fig. 3. Recursive CUSUM test with 95 % confidence bands around the null.

the model and the potential presence of structural breaks. Fig. 3 shows the graph of the CUSUM statistic, which is updated recursively and does not leave the 95 % bounds, indicating that we achieve stability as no structural breaks are evident.

4. Regional integration measures

The last step of the analysis explores the extent of regional integration of Tibet and Ladakh in their respective countries. Both China and India are interested in decreasing the spatial and economic gap between the two peripheral regions and the rest of the nation, not least because of border security concerns. In general, the degree of integration between regions can be assessed by exploring trade, investment, and migration flows or measuring the narrowing of differences in income and other social indicators. However, there are no statistics on interregional trade and investment flows in China and India. Given the limitations of the data, we select three variables that measure income differences, human interactions, and transportation links.

Convergence in regional income is a key indicator of economic integration within a country. Fig. 4 shows the income gap between Tibet and the national average, expressed as a share of the national per-capita GDP.[5] In the early 1980s, the income level in Tibet seems to have been close to the national average, although statistical data from this early period are likely to be less precise. Over the 1980s and early 1990s, the income difference expands dramatically, mainly because the rest of China was growing at a much faster pace than Tibet. Since the mid-1990s, convergence occurs but with some slowdowns and at a very gradual pace. In the last two years of the sample period, there is an indication that the pandemic has led to yet another divergence episode. It seems that Tibet will need sustained economic growth over the long run in order to catch up with the rest of China in terms of living standards. Furthermore, we investigate the correlation between the growth rates of per-capita GDP in Tibet and at the national level. Synchronized

business cycles would indicate a higher degree of regional integration. In Fig. 5 we detect diverging movements in the growth rate between the two series. Especially in the 1990s and early 2000s, Tibet and the national average exhibit opposite movements. In fact, the correlation coefficient over these two decades is −0.26, while in the last 10 years the correlation has switched to 0.50. These results concur with the patterns observed in Fig. 4. In the absence of income data for Ladakh, we are unable to conduct a similar analysis for the Indian region.

The second indicator focuses on tourist arrivals, which is a gauge of person-to-person interactions and cultural exchange. Tourism is a very suitable measure for Tibet and Ladakh because both regions attract large numbers of domestic tourists from other regions. In Ladakh, the domestic tourists represented less than 40 % of arrivals in the 2000s. But over the past 20 years, this share has increased to above 80 %. The left panel of Fig. 6 reveals sharp increases of domestic tourists in 2010 and 2015 as well as a collapse of domestic travel to Ladakh during the pandemic. The latest number, however, indicates that tourist numbers have recovered rapidly, exceeding the pre-pandemic levels.

Chinese statistics report the number of tourists in person-times, counting each trip of the same person within the region separately. Nevertheless, we can observe the same trend in right panel of Fig. 6 as for Ladakh, namely that domestic tourist arrivals have experienced a surge since the 2010s. A major reason for this tourist boom is the rapidly growing income of households in China and India. The severe lockdowns in China have brought tourism to a standstill but it is likely that a rapid recovery will follow. Comparing tourist inflows in Tibet and Ladakh reveals a common trend, indicating that tourism certainly contributes to the integration of these regions in their respective countries, not least because revenue from tourism also contributes to local incomes.

The third indicator examines transportation links as a determinant of regional integration. In particular, we study air passenger and cargo traffic, whereby the former is related to tourist arrivals while the latter can be viewed as a proxy for trade with the rest of the country. Fig. 7 shows both series being subject to seasonal patterns. During the cold winters when most roads to Ladakh are closed, cargo traffic picks up, whereas passenger traffic drops. The opposite patterns can be observed in the spring and summer months. More importantly, passenger traffic is
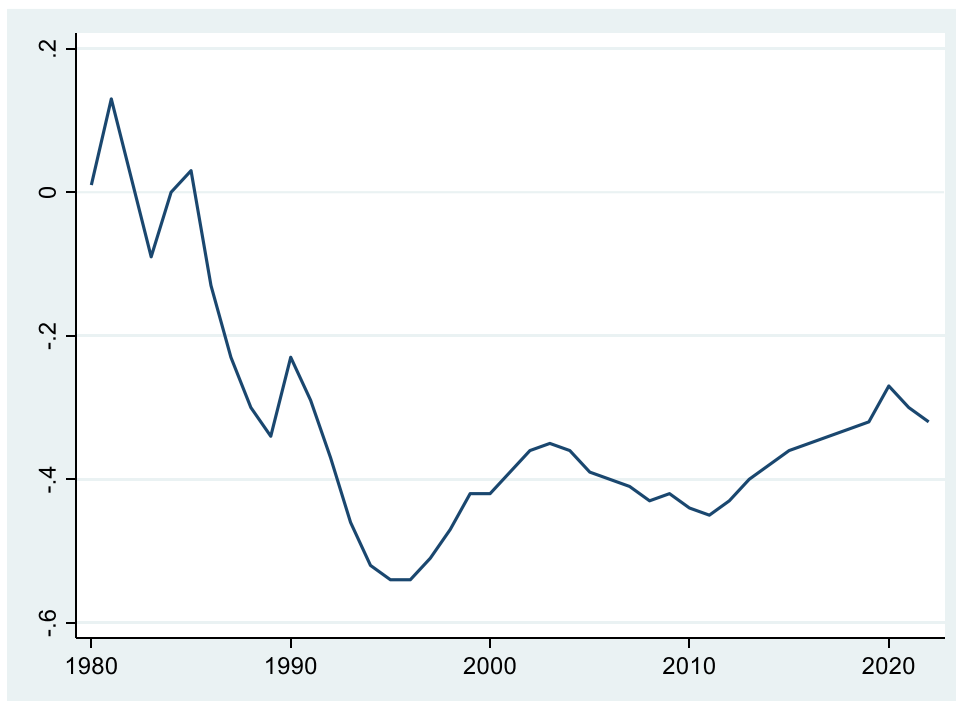
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[5] First, we subtract China's national average from Tibet's GDP. The resulting amount, which is negative after the mid-1980s, is divided by the national per-capita GDP.

Fig. 4. The per-capita GDP gap between Tibet and the national average (share of national per-capita GDP)
Source: Author's calculations based on data from the CEIC database.
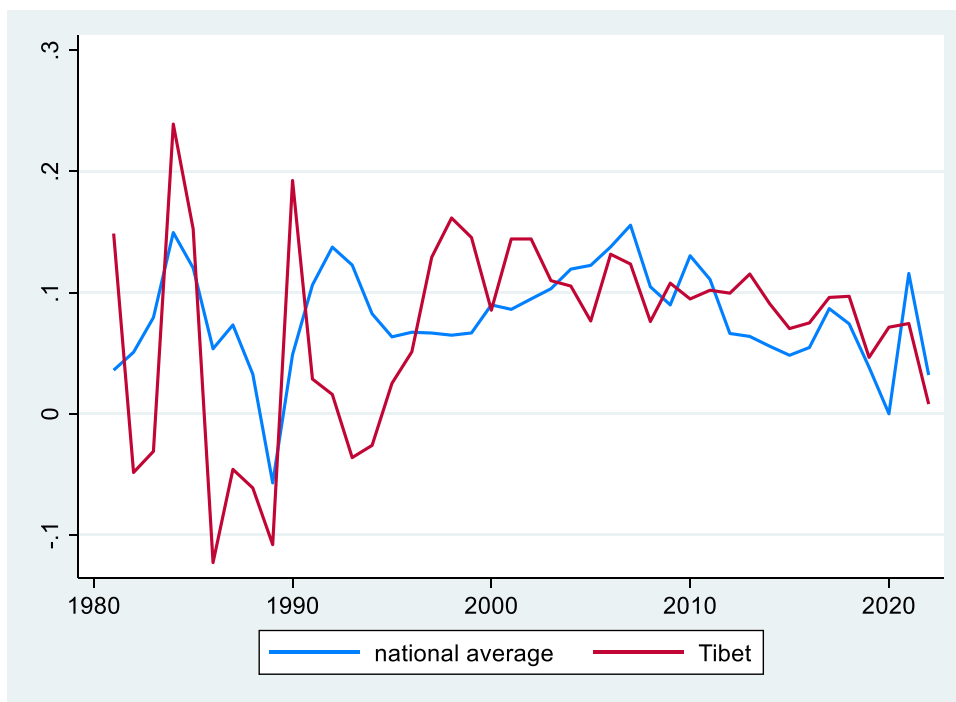

Fig. 5. Growth rates of real per-capita GDP in Tibet and at the national level
Source: Author's calculations based on data from the CEIC database.

increasing substantially over time, reaching new heights in the aftermath of the pandemic. By contrast, cargo traffic has been growing at a much slower pace. Given that air and road are the only means of transporting goods to Ladakh, the graph in Fig. 7 reveals that the trade channel is not a major determinant of regional integration for this remote region, the reason being that Ladakh does not produce many tradable goods.

The weekly data for total operated flights in Tibet (left panel of Fig. 8) exhibits seasonal patterns with significant drops in the winter months similar to Ladakh. However, there seems to be no detectable increase in the number of flights over time, which might be due to the effects of the pandemic. The annual data for freight traffic (right panel of Fig. 8) is much less volatile but reports a dramatic increase since the late 2000s. It should be mentioned that the data includes freight transported

Fig. 6. Domestic tourist arrivals in Leh district (Ladakh) and Tibet
Source: Various years of the Leh District Statistical Handbook and the China Statistical Yearbook. The numbers for Tibet are expressed in thousands of person-times.
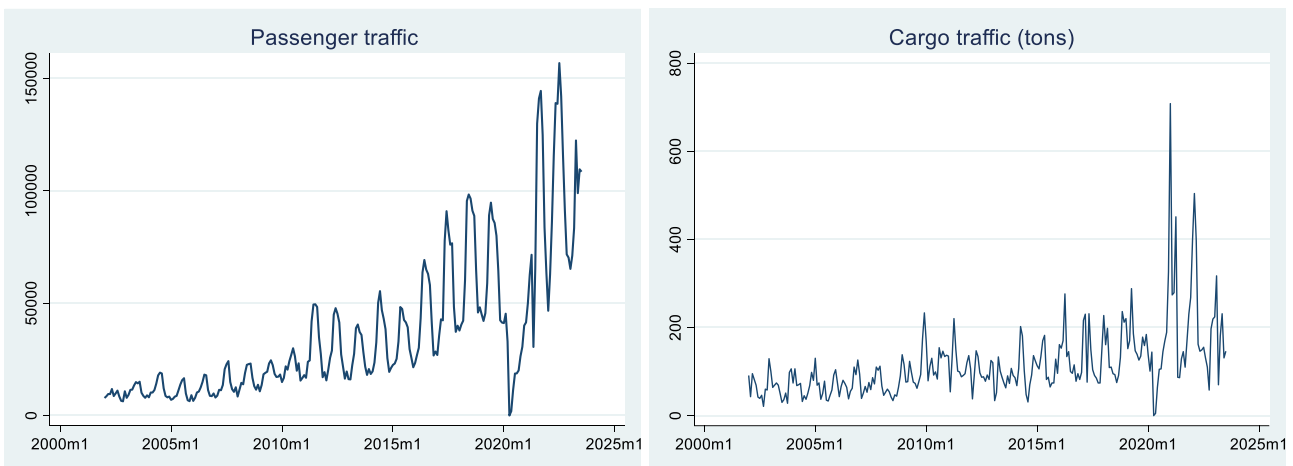

Fig. 7. Domestic air passenger and cargo traffic for Leh district (Ladakh)
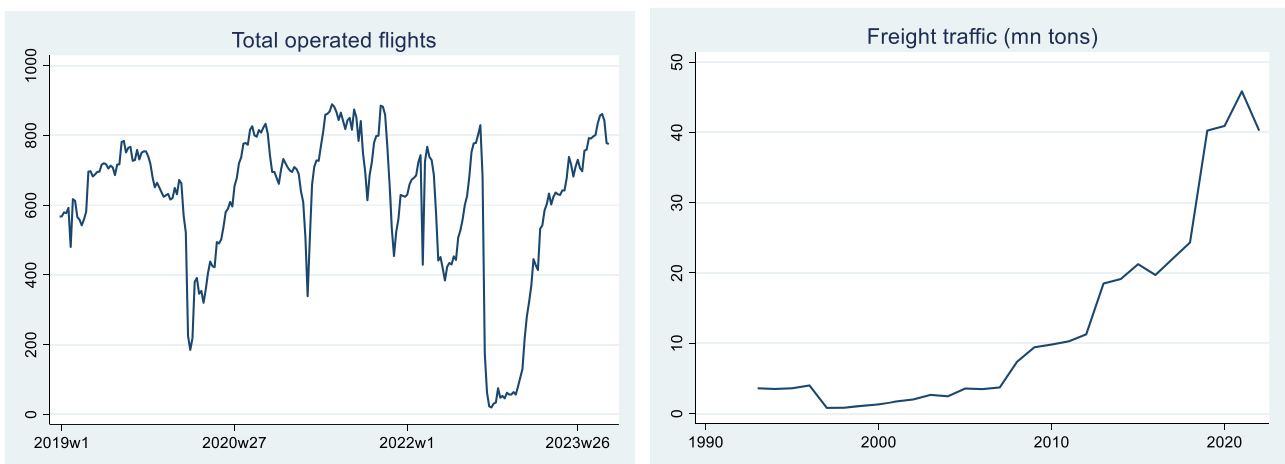Source: CEIC database.

Fig. 8. Total operated flights and freight traffic for Tibet
Source: CEIC database.

by all possible means (air, rail, road, and waterways) and is thus not directly comparable to the cargo traffic for Ladakh in the right panel of Fig. 7. The conclusion is that the trade between Tibet and the rest of China is growing rapidly, which in turn deepens the integration of the region.

5. Conclusions

The Himalayas are of great strategic importance for China and India but the respective regions in each country are located in the periphery and are economically underdeveloped. The main goal of this paper is to conduct a comparative analysis of China's Tibet and India's Ladakh across various aspects that are relevant for local development for the sake of identifying common and idiosyncratic factors. In addition, we study the center-periphery relations and the extent of regional integration between the Himalayan regions and the rest of their respective countries.

Our findings reveal many shared characteristics between Tibet and Ladakh. Both regions have a certain degree of regional autonomy that is limited by administrative and institutional factors. Tibet is part of a unitary state where the local government and legislature face major challenges in getting self-governing regulations approved by the central authorities. Although for 70 years it was part of another region with a high degree of protection and regional autonomy, Ladakh lacked meaningful self-rule and received relatively little attention and funding from the J&K government. In 2019, its status was upgraded to a separate union territory but it is governed directly by the central government without a locally elected government or legislature.

Furthermore, Tibet and Ladakh are border regions with a strong military presence, requiring the expansion of the transportation network. The infrastructure in Tibet is more advanced, connecting the region with the rest of China via several national highways and even a railway. In Ladakh, the two major roads connecting it to India are still closed off for several months during the winter. As for the military, China is estimated to have stationed more troops in Tibet than India in Ladakh, but given the smaller population and land area of the latter, the military presence there is more salient. In addition, it appears that Ladakh has more military units staffed by ethnic Ladakhis and local Tibetans, while China has a larger number of high-ranking officers of Tibetan origin.

Tibet and Ladakh have both experienced major demographic change over the past 30–40 years. The migration of Hindu Indians and Han Chinese has reduced the share of ethnic Ladakhis and Tibetans, respectively. Despite rapid urbanization, the majority of the population in both regions lives in rural areas and agriculture remains an important part of the economy, although in recent decades the services sector (and especially tourism) has claimed an ever-growing share of GDP. Tibet has a more developed industrial sector than Ladakh and services account for more than half of the GDP. Tibet is also a much larger economy and its people are three times wealthier than Ladakhis.

The center-periphery relations are assessed by examining the effect of fiscal transfers provided by the central government on local economic growth. Limited data on Ladakh suggests that the average Ladakhi receives a third of what a Tibetan gets in fiscal transfers from the central authority. Our estimation of an ARDL model indicates that there is a positive and significant long-run relationship between transfers and growth in Tibet, while national economic trends seem to matter for Tibet's development only in the short run. In fact, we show that the income gap between Tibet and the national average expanded dramatically over the 1980s and early 1990s. Although this trend was reversed in the late 1990s, the convergence of Tibet is progressing relatively slowly. By contrast, the tourism sector is shown to be a major driver of regional integration. The share of domestic tourists visiting Tibet and Ladakh has exploded since the early 2000s. Freight has also grown, especially in Tibet, pointing to an improving infrastructure and more trade with the rest of the country.

In summary, Tibet and Ladakh share many common characteristics despite being separated by a sealed border marked by military skirmishes and despite major differences in the economic and political systems of China and India. Overall, the Chinese government appears to invest more in Tibet than India in Ladakh, achieving higher income levels and better infrastructure for the local population. This is, in part, thanks to the more advanced economy of China and the higher income levels in the country compared to India. In that sense, Tibet benefits from being part of the booming common market of China, while Ladakh is likely to reap similar benefits in the near future after the barriers to migration and investment from the rest of India have been dismantled.

The main limitation of this study is the lack of detailed aggregate data, especially for Ladakh. The delayed census in India and the fact that Ladakh until very recently was part of another state lead to a situation where population statistics are more than a decade old and GDP data is reported haphazardly. However, this is likely to change with the new union territory status of Ladakh, which means that in the near future more detailed economic data is likely to become available.

The central governments of China and India will have to continue subsidizing their Himalayan regions in coming years to ensure that they catch up with the rest of their country. The slowdown of economic growth in China in the wake of the pandemic might make it more difficult to sustain the generous transfers to peripheral areas. The Indian government should continue encouraging investment inflows into Ladakh from other parts of India. However, the deepening integration of both regions within their respective countries will continue to be plagued by various challenges, such as environmental degradation, marginalization of locals by higher-skilled and better-funded migrants, and loss of cultural identity due to a declining share of the ethnic majority. Interestingly, growing tensions along the Sino-Indian border might have a positive effect on local development as central governments invest more in local infrastructure and national defense.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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